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Policy issues for information and communications technology: promoting the integration and application of information and communications technology policy through the Asia-Pacific Information Superhighway initiative

Implementation of the Master Plan for the Asia-Pacific Information Superhighway and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document

Note by the secretariat

Summary

The implementation of the Master Plan for the Asia-Pacific Information Superhighway is in its last year of implementation (2018). Key milestones include the support by the Economic and Social Commission for Asia and the Pacific for the Master Plan and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document, which articulate the principles, deliverables and time frame, with concrete actionable strategies, for improving broadband connectivity in Asia and the Pacific. In addition, effective partnerships have been leveraged for the implementation of the Master Plan and the Regional Cooperation Framework Document, resulting in proposals for new initiatives and implementation modalities and plans. Subsequently, member countries further developed updates to the Master Plan for the next four years (2019–2022) as a blueprint to guide the next stage of implementation, taking into account the outcomes of the meetings of the Asia-Pacific Information Superhighway Steering Committee, held in Dhaka in November 2017, and of the Asia-Pacific Information Superhighway Steering Group, held in Bangkok in December 2017, among others.

The present document contains an outline of the essential elements of the updates to the Master Plan. It also contains a proposal on the way forward and issues for consideration by the Committee on Information and Communications Technology, Science, Technology and Innovation at its second session.

* ESCAP/CICTSTI/2018/L.1.

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I. Introduction

1. Information and communications technology (ICT) is a "meta-infrastructure", a growth industry and a critical development enabler. ICT-enabled financial, transport and trade facilitation infrastructure, applications and services are the foundation of the digital economy and society that encourage innovations and qualitative societal transformations. Broadband-enabled technologies, such as artificial intelligence, are particularly effective in increasing efficiencies that drive growth and innovation in various sectors of the economy. ICT is also widely appreciated for its capacity to reach remote and rural areas by means of mobile and satellite devices and to deliver essential services, such as health, education, agricultural information and time-critical disaster alerts. It has been used to improve monitoring and understanding of environmental degradation, natural resource use and climate change-related incidents with newly developed technologies such as the Internet of things and big data. Thus, ICT is a critical infrastructure, industry and instrument for the achievement of the Sustainable Development Goals and of leaving no one behind.

2. However, as reviewed in document ESCAP/CICTSTI/2018/3, the broadband divide in Asia and the Pacific is widening, while the window of opportunity for developing countries to catch up is narrowing, given the rapid advancement of frontier technologies, such as artificial intelligence and blockchain. The development and roll-out of these frontier technologies depend heavily on the availability and affordability of robust broadband networks; without such infrastructure, even the more conventional applications and services, such as e-commerce, e-health and intelligent transport systems, might not function effectively and reach their intended users in remote and rural areas.

3. Member States of the Economic and Social Commission for Asia and the Pacific (ESCAP) recognized the strategic significance of ICT connectivity as a key component in achieving the 2030 Agenda for Sustainable Development in Asia and the Pacific. In the Bangkok Declaration on Regional Economic Cooperation and Integration in Asia and the Pacific,[1] member States were encouraged to enhance regional cooperation on seamless connectivity in the areas of ICT, transport and energy. In addition, the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific[2] was endorsed by ESCAP member States in 2017. In the road map, it was recognized that, while broadband Internet access had improved within the region, the digital divide continued to widen between member States. This means that some member States may be left out of the socioeconomic opportunities created by broadband connectivity. Specifically, in the regional road map, it was recognized that the implementation of the Asia-Pacific Information Superhighway initiative, which was developed and supported by member States to address the above-mentioned challenges and opportunities in enhancing regional broadband connectivity, was an opportunity to expand regional cooperation on ICT.

4. Against this background, the aim of the present document is to highlight the progress made in the implementation of the Asia-Pacific Information Superhighway initiative to date and present information on the proposed four-year extension of the Master Plan for the Asia-Pacific Information Superhighway, information on the way forward and issues for consideration

[1] Commission resolution 70/1, annex.

[2] E/ESCAP/73/31, annex II.

by the Committee on Information and Communications Technology, Science, Technology and Innovation at its second session.

II. Highlights of the implementation of the Asia-Pacific Information Superhighway initiative

5. The Asia-Pacific Information Superhighway initiative was developed and implemented in accordance with intergovernmental decisions and a number of milestones have been reached.

A. Review of intergovernmental mandates

6. In Commission resolution 69/10 of 1 May 2013, the Commission recognized the need to promote the exchange of best practices and experiences related to the development of ICT infrastructure, including an in-depth analysis of the policy and regulatory barriers that could impede efforts to synchronize the deployment of ICT infrastructure across the region in a seamless manner.

7. The precursor to the Committee on Information and Communications Technology, Science, Technology and Innovation, the Committee on Information and Communications Technology, at its fourth session,[3] in 2014, requested that the secretariat establish an open-ended working group on the Asia-Pacific information superhighway to develop principles and norms, as well as a master plan, covering the policy and technical aspects of the Asia-Pacific information superhighway.

8. In addition, at that session, which was held jointly with that of the Committee on Transport, the two Committees recommended that member States should consider amending the Intergovernmental Agreement on the Trans-Asian Railway Network and the Intergovernmental Agreement on the Asian Highway Network to encourage co-deployment of fibre-optic cables along passive infrastructure.

9. In its resolution 71/10, the Commission endorsed those recommendations. It further requested the secretariat to promote the sharing of experiences, good practices and lessons learned in ICT for disaster risk reduction and e-resilience, to support the work of the Working Group on the Asia-Pacific Information Superhighway, to undertake research and analysis, to build partnerships and collaboration with international and regional organizations and to harness cross-sectoral synergies.

10. As a result, expert consultations were held by the secretariat in 2013 and 2014 on the Asia-Pacific information superhighway in Manila (23 and 25 September 2013),[4] Baku (3 and 4 December 2013)[5] and Paro, Bhutan (1 and 2 October 2014)[6] at which experts supported the synchronized construction of

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[3] The Committee on Information and Communications Technology encouraged strengthened cooperation on ICT for sustainable development in the region at its second session and third sessions, held in 2010 and 2012, respectively.

[4] See www.unescap.org/events/expert-consultation-asian-information-superhighway-and-regional-connectivity-philippines.

[5] See www.unescap.org/events/expert-consultation-asian-information-superhighway-and-regional-connectivity-azerbaijan.

[6] See www.unescap.org/events/expert-consultation-asia-pacific-information-superhighway-and-regional-connectivity.

fibre-optic, transport and energy infrastructure and underlined the cost effectiveness of this method of infrastructure development.

11. Also as a result, the first meeting of the Working Group on the Asia-Pacific Information Superhighway was held in Incheon, Republic of Korea, on 1 and 2 September 2015.[7] It was co-hosted by ESCAP and the Ministry of Science and ICT of the Republic of Korea and attended by representatives of 20 member States as well as representatives of United Nations agencies, regional organizations, the private sector, civil society and think tanks.

12. The Working Group began the task of drafting a master plan encompassing the long-term vision, targeted goals, specific activities and milestones with regard to the four pillars of the Asia-Pacific Information Superhighway initiative. In addition, it decided to draft a regional cooperation framework document to support the master plan. The Working Group also agreed on issues relating to its governance structure and operation.[8]

13. The Working Group also decided to establish a steering group comprising multi-stakeholder representatives with policy and technical expertise to review drafts of the master plan and the regional cooperation framework document. In addition, the Working Group underlined the importance of promoting investment in fibre-optic broadband connectivity, enhancing Internet traffic and network management, enhancing ICT network resilience to natural disasters and improving access to affordable broadband for all.

14. Co-hosted by ESCAP and the Ministry of Industry and Information Technology of China, the second meeting of the Working Group was held in Guangzhou, China, on 29 and 30 August 2016[9] and attended by representatives of 16 member States as well as representatives of United Nations agencies, regional organizations, the private sector, civil society and think tanks. The objectives of the second meeting were to review the drafts of the master plan, including its seven strategic initiatives, and the regional cooperation framework document prepared by the Asia-Pacific Information Superhighway Steering Group. In addition, Working Group members were updated on the progress made with regard to the research and analyses in support of the development of the master plan and the regional cooperation framework document.

15. The Working Group reviewed and considered for endorsement the draft master plan and regional cooperation framework document and recommended that they be submitted to the Committee on Information and Communications Technology, Science, Technology and Innovation at its first session.

16. The Committee on Information and Communications Technology, Science, Technology endorsed the draft master plan and regional cooperation framework document at its first session in October 2016. Subsequently, in 2017, the Government of Bangladesh submitted to the Commission a resolution on the implementation of the Asia-Pacific Information

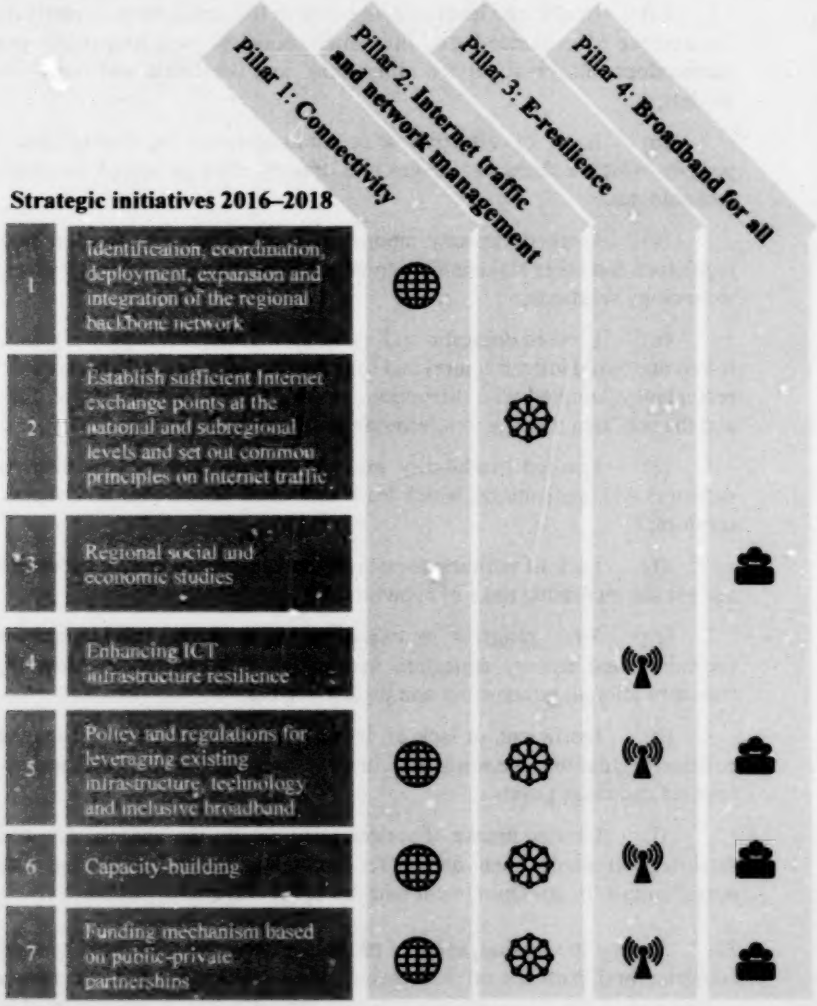
[7] See www.unescap.org/events/first-meeting-working-group-asia-pacific-information-superhighway.

[8] See www.unescap.org/sites/default/files/Outcome%20Document%20Sept%202015.pdf for the draft outcome document of the first session of the Working Group on the Asia-Pacific Information Superhighway.

[9] See www.unescap.org/events/second-session-working-group-asia-pacific-information-superhighway.

Superhighway initiative for consideration at the seventy-third session of the Commission. In resolution 73/6, adopted by consensus, the Commission invited members and associate members to cooperate in the implementation of the Master Plan for the Asia-Pacific Information Superhighway[10] and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document.[11] The Commission also invited members and associate members to promote broad-based partnerships, including North-South, South-South and triangular cooperation for broadband connectivity. The Master Plan focuses on four areas, namely connectivity (promoting fibre-optic broadband network expansion throughout the Asia-Pacific region), Internet traffic and network management (strengthening of efficient traffic and network management for Internet reliability and redundancy), e-resilience (boosting ICT network resilience to support effective disaster management) and broadband for all (promoting affordable broadband access for all). Seven strategic initiatives were identified by member States to guide the implementation of the Master Plan (see figure).

Pillars and strategic initiatives of the Asia-Pacific information superhighway


Pillar 1: Connectivity
Pillar 2: Internet traffic and network management
Pillar 3: E-resilience
Pillar 4: Broadband for all
Strategic initiatives 2016–2018
1
Identification, coordination, deployment, expansion and integration of the regional backbone network
2
Establish sufficient Internet exchange points at the national and subregional levels and set out common principles on Internet traffic
3
Regional social and economic studies
4
Enhancing ICT infrastructure resilience
5
Policy and regulations for leveraging existing infrastructure, technology and inclusive broadband
6
Capacity-building
7
Funding mechanism based on public-private partnerships

[10] E/ESCAP/CICTSTI(1)/2.

[11] E/ESCAP/CICTSTI(1)/3.

B. Progress in implementation

17. The first session of the Asia-Pacific Information Superhighway Steering Committee was held in Dhaka on 1 and 2 November 2017. Co-hosted by ESCAP and the Department of Information and Communication Technology of Bangladesh, the session was attended by representatives of 23 member States and as well as representatives of United Nations specialized agencies and related organizations, international organizations, the private sector, civil society and think tanks.[12]

18. Member States were asked to submit country reports that identified challenges and opportunities with regard to promoting national and cross-border ICT connectivity in line with the strategic initiatives in the Master Plan for the Asia-Pacific Information Superhighway and its four pillars. Fifteen member States responded and their inputs also served as the basis for the development of the subregional implementation plans detailed below.

19. The following common key challenges were identified by member States:

(a) Inadequate level of investment in ICT infrastructure partly due to the absence of evidence-based investment policies, including public-private partnerships, universal service obligations, and wholesale and retail pricing models;

(b) Lack of effective telecommunications regulations and ICT policies which address challenges and opportunities presented by emerging technologies;

(c) Limited capacity among ICT policymakers, decision makers, regulators and other stakeholders to address the digital divide with emerging technology solutions;

(d) Limited domestic and international fibre-optic network capacity (often due to old infrastructure) and routes (especially in rural areas) as well as redundancy, coupled with disruptions to connectivity due to natural disasters and the resulting damage to telecommunications facilities and cables;

(e) Limited availability of local content and content distribution networks and applications, which leads to limited demand for ICT access and services;

(f) Lack of policies, measures and capacity to ensure cybersecurity against the increasing risks of cyberattacks;

(g) Slow progress in expanding ICT literacy and education at secondary and tertiary education institutions, exacerbated by slow digital transformation in government and private sectors;

(h) Inefficient, or lack of, Internet traffic and network management policies, regulations, measures and capacity, including lack of open and neutral Internet exchange points;

(i) Limited uptake of various technologies for connectivity, such as satellite communications and other emerging technologies, and limited opportunities for co-deployment with transport and energy sectors.

20. During the session, specific proposals were also submitted by member countries and partners on addressing those challenges and on advancing

[12] See www.unescap.org/events/first-session-asia-pacific-information-superhighway-ap-steering-committee.

implementation of the initiative. The proposals and suggested actions are summarized below:[12]

(a) To conduct a pre-feasibility study to identify specific challenges and opportunities of ICT connectivity at the subregional level, including for Central and Western Asia and neighbouring countries;

(b) To develop a United Nations Volunteers partnership programme for the implementation of the Asia-Pacific Information Superhighway initiative at regional and subregional levels;

(c) To establish a network comprising academia under the Asia-Pacific Information Superhighway initiative;

(d) To explore co-deployment opportunities with the transport and energy sectors through joint research on technology, regulations and benefits;

(e) To coordinate interested organizations and countries, such as Nepal, Papua New Guinea and the Philippines on e-resilience and co-hosting e-resilience meetings;

(f) To coordinate the provision of regional flood information, of community-based flood early warning systems and of forest fire detection and monitoring for socioeconomic and ecological resilience;

(g) To co-host with the Pacific Islands Telecommunications Association the subregional meeting on the Asia-Pacific information superhighway in 2018, at which participants will discuss the operationalization of the Pacific priorities identified for the subregional implementation plan;

(h) To review the Asia-Pacific Information Superhighway Maps[13] (developed in collaboration with the International Telecommunication Union) and the Internet Exchange Point map[14] (developed in collaboration with the Internet Society) and inform the secretariat of any gaps, new developments or necessary adjustments;

(i) To conduct a regional study on ICT and education, as limited school connectivity was identified as a major obstacle in promoting broadband for all;

(j) To explore the possibility of collaboration with research institutes for landlocked countries to address their specific challenges and opportunities in extending and expanding broadband connectivity;

(k) To explore potential collaboration on a joint academia conference to deepen the understanding of challenges and opportunities associated with the implementation of the Asia-Pacific Information Superhighway initiative;

(l) To support the Trans-Eurasian Information Super Highway project through subregional implementation of the Asia-Pacific Information Superhighway initiative for North and Central Asia.

21. Furthermore, in collaboration with the International Telecommunication Union, the secretariat continued to support member States by providing updates on the Asia-Pacific Information Superhighway Maps. They provide member States with visual information on fibre-optic cables between and within countries in the region. They can serve as an analysis tool

[13] www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/asia-pacific-information-superhighway-maps.

[14] www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/ixpmap.

for, inter alia, the state of infrastructure connectivity and the identification of missing links and cross-border infrastructure gaps, under pillar 1 (connectivity) of the Asia-Pacific information superhighway.

22. The Internet Exchange Point map for Asia and the Pacific, created in collaboration with the Internet Society, has been shared with member States. The heat map shows the percentage of coverage of Internet exchange points. A tally of the number of major cities in each member State is given, as well as the number of cities with coverage and without. The map was developed to support the policy dialogue under pillar 2 (Internet traffic and network management) of the Asia-Pacific information superhighway.

23. In addition, the secretariat and its partners have conducted research, held activities and carried out projects in support of the seven strategic initiatives and four pillars of Master Plan for the Asia-Pacific Information Superhighway.[12] Technical reports[15] were developed to provide member States with information on specific issues relevant to the Master Plan and the Regional Cooperation Framework Document in order to raise awareness on challenges and opportunities and to facilitate evidence-based dialogue on issues of relevance to the region. The findings of those reports are summarized in document ESCAP/CICTSTI/2018/3.

IV. Review of the implementation of the Master Plan for the Asia-Pacific Information Superhighway (2016–2018)

24. The Master Plan and the Regional Cooperation Framework Document stipulate that a review should be conducted in order to revise and update both documents beyond 2018 and that the proposed changes be presented to the Committee on Information and Communications Technology, Science, Technology and Innovation.[16] This section contains information on the review process and expected outcomes which will be presented at the second session of the Asia-Pacific Information Superhighway Steering Committee, in Bangkok on 27 and 28 August 2018, for its endorsement. For the second session of the Committee on Information and Communications Technology, Science, Technology and Innovation, the proposed master plan for the Asia-Pacific information superhighway, 2019–2022, is contained in document ESCAP/CICTSTI/2018/INF/1 and the proposed Asia-Pacific information superhighway regional cooperation framework document, 2019–2022, in document ESCAP/CICTSTI/2018/INF/2.

25. As part of the review process, the secretariat distributed standardized feedback questionnaires at the consultations to ensure that the activities helped to advance the objectives of the Asia-Pacific Information Superhighway initiative. Of the participants who completed the questionnaire at the second session of the Working Group on the Asia-Pacific Information Superhighway in 2016, 85 per cent indicated that the meeting and discussions on reviewing the draft master plan and regional cooperation framework document had effectively promoted a collaborative approach to addressing challenges related to fixed broadband at the regional and subregional levels. In addition, 89 per cent of participants indicated that the agenda of the meeting[17] reflected

[15] See www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/resources%20for%20the%20list%20of%20reports.

[16] E/ESCAP/CICTSTI(1)/2, para. 43, and E/ESCAP/CICTSTI(1)/3, paras. 9 and 10.

[17] See www.unescap.org/events/second-session-working-group-asia-pacific-information-superhighway.

the needs and priorities of member States in the area of broadband connectivity development.

26. At the first meeting of the Asia-Pacific Information Superhighway Steering Committee in November 2017, 88 per cent of participants indicated that the meeting effectively identified priority areas and key emerging issues in promoting broadband connectivity in the Asia-Pacific region, and 88 per cent said that subregional and regional dialogues and exchanges enhanced regional broadband connectivity across the region. They also indicated that the meeting was useful in identifying key challenges and ways forward with regard to narrowing subregional and regional broadband connectivity divides (86 per cent).

27. As a follow-up to that meeting, on 12 December 2017, the Asia-Pacific Information Superhighway Steering Group met. It then held a joint session with the Working Group on the Asian Highway Network (its seventh meeting) on 13 December 2017 to discuss subregional implementation plans.[18]

28. That discussion focused on the opportunity presented by the co-deployment of ICT and transportation infrastructures for cost savings and efficiency gains. Member States recognized that co-deployment and co-habitation of fibre-optic cables along the Asian Highway and Trans-Asian Railway networks, power grids, and oil and gas pipelines would be an effective and cost-efficient means of implementation, especially in rural areas that remained unserved or underserved, and it would also attract infrastructure investment opportunities within the region. Ninety-two per cent of the participants stated that key challenges and ways forward with regard to narrowing subregional and regional broadband connectivity divides had been identified.

29. Additionally, visibility and interactions with various partners were enhanced. For instance, the secretariat was invited to present the outcomes of the first session of the Asia-Pacific Information Superhighway Steering Committee to the Eighteenth Association of Southeast Asian Nations (ASEAN) Telecommunications and Information Technology Senior Officials Meeting, held in Siem Reap, Cambodia, from 27 to 29 November 2017. The secretariat presented the update to *A Pre-Feasibility Study on the Asia-Pacific Information Superhighway in the ASEAN Sub-Region: Conceptualization, International Traffic and Quality Analysis, Network Topology Design and Implementation Model*[19] and proposed a new approach, namely developing northern and southern corridors to address different connectivity requirements given the diverse development stages of ASEAN member countries. In particular, the need for enhanced e-resilience and smart city applications were taken into account in the update, which was supported by the Telecommunications and Information Technology Senior Officials Meeting.

30. Importantly, an increasing number of organizations and agencies indicated their intention to align their respective activities with and contribute to the Asia-Pacific Information Superhighway initiative as implementing partners. For instance, the Asia-Pacific Information Superhighway initiative is now identified as one of the International Telecommunication Union's strategic initiatives in Asia and the Pacific, while various think tanks and technical partners, such as the Internet Society, the Internet Corporation for Assigned Names and Numbers, the Asia-Pacific Network Information Centre

[18] See www.unescap.org/events/asia-pacific-information-superhighway-steering-group-meeting-12-december-2017-and-joint.

[19] ESCAP and National Information Society Agency (February 2016).

and LIRNEasia, proposed initiatives for its implementation. As a result, meetings on the Asia-Pacific Information Superhighway initiative not only facilitate dialogue between policymakers and different stakeholders but also provide an opportunity for different stakeholders to propose joint initiatives and harmonize their approaches for greater synergy, coherence and impact.[20]

31. In support of systematic information sharing among member States and partner organizations, the secretariat developed online tools and platforms in collaboration with implementing partners of the Asia-Pacific Information Superhighway initiative. The ICT and DRR Gateway[21] is an online platform that provides government officials and the public with updated information and news on ICT and disaster risk reduction in the region. One of the tools published on the Gateway is the Asia-Pacific Information Superhighway E-resilience Toolkit,[22] which provides information on the spectrum of available ICT tools and best practices that may help policymakers in the Asia-Pacific region to enhance e-resilience and disaster risk management. These platforms and tools are designed to increase access to information, facilitate cost-efficient dialogue and share the findings of the secretariat's reports in a systematic and sustainable manner.

V. Master plan and regional cooperation framework document for the Asia-Pacific information superhighway, 2019–2022

32. Taking into account the activities and findings already mentioned in the present document, this section contains information on the proposed master plan and regional cooperation framework document for the Asia-Pacific Information Superhighway initiative for 2019–2022, building on the previous documents of the same name.

33. In the proposals, particular attention is given to governance structure and leveraging effective multi-stakeholder partnerships in the implementation of the seven strategic initiatives of the original Master Plan, in line with the guidance provided at the first session of the Asia-Pacific Information Superhighway Steering Committee.

A. Structure

34. According to its terms of reference, membership of the Asia-Pacific Information Superhighway Steering Committee is open to all member States of ESCAP, non-profit organizations and research institutes with policy and technical expertise and experts from member countries.[23] Its Bureau is elected by Steering Committee members for a term of one year and the Steering Committee meets once a year. The Steering Committee elected Bangladesh as the Chair and China and the Lao People's Democratic Republic as Vice-Chairs.

[20] See ESCAP/CICTSTI/2018/INF/1 for a list of implementing partners and activities that contributed to the implementation of the Asia-Pacific Information Superhighway initiative.

[21] http://drrgateway.net/.

[22] http://drrgateway.net/information-communications-technology/Asia-Pacific-E-Resilience-Toolkit.

[23] E/ESCAP/CICTSTI(1)/2, annex I.

35. Subregional steering groups support existing regional and subregional initiatives through the development and implementation of the subregional implementation plans.[24] Implementation groups may be established at the subregional level as deemed appropriate.

36. The Steering Committee's and subregional steering groups' main deliverables for the updated master plan and regional cooperation framework document, 2019–2022, will consist of implementation plans at the subregional level (overseen by the Steering Committee), pre-feasibility studies at the subregional level (overseen by the subregional steering groups) and a feasibility study at the level of implementing entities (implementation group).

37. The goal of the pre-feasibility study for each subregion is to provide an intercountry overview of the subregion's ICT connectivity development and digital divide; to identify gaps, challenges and opportunities; and to identify synergies with existing initiatives to pave the way for the feasibility study. It is proposed that the pre-feasibility study be developed and coordinated with subregional organizations and member States, with oversight provided by the respective subregional steering groups with possible involvement of implementation group members, including financial institutions.

38. This will be followed by a feasibility study. It will focus on a specific project, as guided by the pre-feasibility study findings, in support of the development of the project, in order to facilitate implementation and partnerships that are aligned with priorities determined by the subregional steering groups. The studies should be site specific and address specific challenges and opportunities, such as physical infrastructure, including detailed design and topology, as well as costing, resource requirements (including capacity), policy and regulatory requirements, technology options, duration, financing options and implementing partners, among others.

B. Leveraging effective partnerships for the implementation of the Asia-Pacific Information Superhighway initiative

39. Significant support has been provided by member States and key partners during development and implementation process. During the first session of the Asia-Pacific Information Superhighway Steering Committee, 13 organizations submitted additional activities and projects in support of the implementation of the Asia-Pacific Information Superhighway initiative, namely: Asia Pacific Network Information Centre; Central Visayas Information Sharing Network Foundation; International Centre for Integrated Mountain Development; International Development Research Centre; Internet Society; Korea Telecom; LIRNEasia; Monenco Consulting Engineers; Pacific ICT Regulatory Resource Centre; United Nations Educational, Scientific and Cultural Organization; United Nations Volunteers; University of the South Pacific; and World Bank.[12] In this context, the strategic initiatives of the 2019–2022 master plan are updated to reflect emerging issues of concern, proposed new activities and new implementing partners. The Russian Academy of Sciences is collaborating with the secretariat to explore potential joint activities under the Asia-Pacific Information Superhighway initiative in East and North-East Asia. In addition, with the China Academy of Information and Communications Technology, the secretariat is exploring the possibility of joint activities in East and North-East Asia, North and Central Asia, South and South-West Asia, and South-East Asia.

[24] Ibid., annex II.

40. The secretariat also capitalized on the effective use of coordination mechanisms and platforms of United Nations organizations and regional and international organizations, such as the Regional Inter-agency Working Group on Information and Communications Technologies. Through such regional coordination mechanisms, organizations have systematically provided updates on progress in the implementation of the initiative in order to maximize synergies and avoid duplication by sharing programmes of work and activities. Such regional coordination among agencies will be strengthened in the coming years.

41. Leveraging different partnerships between member States and other multi-stakeholders also enhances the effectiveness of the Asia-Pacific Information Superhighway initiative. In particular, financial and in-kind contributions have enabled the secretariat and its partners to support the implementation of the Master Plan since 2016. Examples of such financial and in-kind contributions include the co-hosting by the Government of the Republic of Korea of the first session of the Asia-Pacific Information Superhighway Working Group in Incheon in 2015, the co-hosting by the Government of China of the second session of the Working Group in Guangzhou in 2016 and the co-hosting by the Government of Bangladesh of the first session of the Asia-Pacific Information Superhighway Steering Committee in Dhaka in 2017. Within the secretariat, the Information and Communications Technology and Disaster Risk Reduction Division and the Transport Division are currently collaborating on a technical study on the opportunities and challenges of infrastructure co-deployment in the region. The findings will provide member States with information on the way forward with regard to promoting co-deployment of ICT and transport infrastructure in the region.

VI. Issues for consideration by the Committee

42. In view of the progress, opportunities and challenges outlined above, the Committee may wish to provide guidance to the secretariat as follows:

(a) The Committee may wish to consider endorsing the outcomes of the first session of the Asia-Pacific Information Superhighway Steering Committee, as summarized in the present note;

(b) The Committee is invited to endorse the updates to the Asia-Pacific Information Superhighway Master Plan, for 2019–2022, and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document, for 2019–2022, as summarized in the present document, while taking note of the details contained in information documents ESCAP/CICTSTI/2018/INF/1 and ESCAP/CICTSTI/2018/INF/2;

(c) The Committee may wish to actively encourage the engagement and participation of various stakeholders, such as the private sector, academia and think tanks, in the implementation of the updated master plan and regional cooperation framework document, 2019–2022, in particular the development of pre-feasibility and feasibility studies;

(d) The Committee may wish to encourage member States and partner organizations to continue supporting the implementation of the master plan and regional cooperation framework document for 2019–2022 through financial and in-kind contributions.

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Major issues and emerging trends related to digital technologies and regional broadband connectivity

Note by the secretariat

Summary

Despite rapid advancements in emerging technologies, such as artificial intelligence and associated digital technologies, the implementation of the Sustainable Development Goals in Asia and the Pacific has been constrained by the widening broadband divide. In order to understand the root causes and impacts of this divide, the secretariat has undertaken research and analyses since the first session of the Committee on Information and Communications Technology, Science, Technology and Innovation, which was held in 2016. This present note contains a summary of the key findings of these studies and identifies issues and policy recommendations for consideration by the Committee.

In particular, the attention of the Committee is drawn to the importance of addressing institutional, policy-related, social and economic factors, which influence the broadband divide, as an urgent development priority. Emerging technologies depend heavily on the availability of robust, reliable and resilient broadband infrastructure as a prerequisite.

Focused intervention is called for in Asia-Pacific countries with special needs, such as small islands developing States, the least developed countries and landlocked developing countries, which have demonstrated the slowest progress in expanding broadband connectivity. In addition, co-deployment with transport and energy infrastructure is identified as a cost-efficient way of deploying broadband infrastructure.

The Committee may wish to review the issues identified at the end of the note and provide guidance to the secretariat.

* ESCAP/CICTSTI/2018/L.1.

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I. Introduction

1. Innovative digitally-led technologies have not only provided society with new capabilities, but also transformed the way in which people live, work and relate to each other. Technological advancements, such as artificial intelligence and its associated digital technologies, have opened up new avenues for sustainable development in Asia and the Pacific.

2. Intelligent applications, such as virtual personal assistants powered by artificial intelligence and machine learning, can make everyday tasks such as prioritizing emails simpler and faster. Through cloud computing, firms can reduce the cost that they would have otherwise incurred on acquiring software and hardware equipment. Broadband-enabled technologies also allow the Government to plan and develop smarter cities – including smart buildings and homes, smart grids, smart transportation, single windows and smart manufacturing – which can reduce energy wastage, identify traffic congestion, improve access to health and education, achieve production efficiency and minimize environmental degradation.

3. Affordable and resilient broadband infrastructure that is readily accessible to connect people and devices is a prerequisite for these considerable economic and social gains to be realized. In this context, studies by the Economic and Social Commission for Asia and the Pacific (ESCAP) have found the widening broadband divide between countries of Asia and the Pacific to be alarming. The reports conclude that ESCAP member countries with special needs (the least developed countries, landlocked developing countries and small island developing States) as well as poor and marginalized people, notably people living in remote and rural areas, are still unable to benefit from bandwidth-intense technological applications and services. This widening broadband divide, if not addressed urgently, will become increasingly difficult to narrow and hinder the efforts towards sustainable development of the member States.

4. Against this background, the present document contains a summary of the findings of research and analyses undertaken by ESCAP since the first session of the Committee on Information and Communications Technology, Science, Technology and Innovation, which was held in October 2016. The research and analyses were designed and undertaken in response to Commission resolutions 71/10, 72/10 and 73/6 and in support of the implementation of the Master Plan for the Asia-Pacific Information Superhighway and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document. The latter two documents are also presented to the current session as information documents ESCAP/CICTSTI/2018/INF/1 and ESCAP/CICTSTI/2018/INF/2. The findings of ESCAP research and analyses have systematically contributed to activities related to the Asia-Pacific Information Superhighway initiative as a basis for evidence-based policy dialogues and regional cooperation. The outcomes of the activities and meetings are summarized in another document submitted to the Committee at its present session (ESCAP/CICTSTI/2018/2).

5. The sections below cover several pertinent themes including the broadband divide, emerging technologies, capacity and skills gaps, financing, privacy challenges and the co-deployment of fibre-optic cables along passive infrastructure.

II. Broadband divide in Asia and the Pacific

A. Fixed broadband

6. In the ESCAP report entitled *Artificial Intelligence and Broadband Divide: State of ICT Connectivity in Asia and the Pacific 2017* (Bangkok, 2017), characteristics of the region's broadband divide are presented and the way in which it may affect the development and roll-out of emerging technologies, such as artificial intelligence, is described. Overall, the Asia-Pacific region has demonstrated steady growth in access to fixed broadband compared to the past decade. Judging from the 2016 data, a large share of the world's total fixed-broadband subscriptions was found in the Asia-Pacific region (56.6 per cent), followed by Europe (20.3 per cent) and North America (13 per cent). However, when the number of fixed-broadband subscriptions per 100 inhabitants is examined, it becomes apparent that the ESCAP average (11.6) was still far behind North America (32.9) and Europe (31.1). The ESCAP average was also below the world average of 12.5 fixed-broadband subscriptions per 100 inhabitants, though it was marginally higher than the figure in Latin America and the Caribbean (11.2).

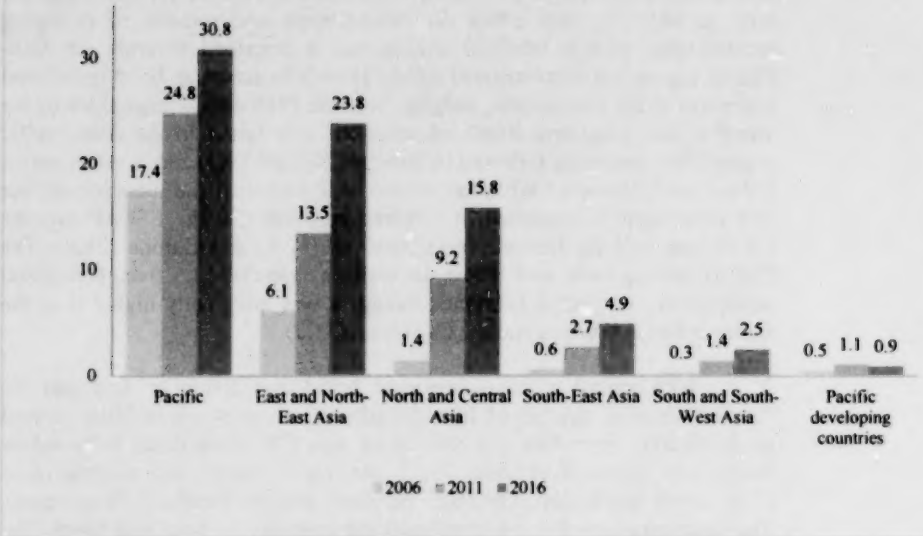
7. With regard to the subregional broadband divide in Asia and the Pacific, the total number of fixed-broadband subscriptions in 2016 derived predominantly from East and North-East Asia (75.74 per cent), followed by South and South-West Asia (9.32 per cent), North and Central Asia (7 per cent), South-East Asia (6.17 per cent) and the Pacific (1.76 per cent). The concentration of fixed-broadband subscriptions in East and North-East Asia has been intensifying over recent years.

8. Looking at the number of subscriptions per 100 habitants, as demonstrated by figure I, the expansion of fixed broadband over the past decade is uneven across ESCAP subregions. While the Pacific, East and North-East Asia, and North and Central Asia have performed relatively well in terms of growth in fixed-broadband subscriptions, the other subregions (South-East Asia and South and South-West Asia) have registered slower progress. When disaggregated by the level of economic development, developing countries in the Pacific have the lowest number of subscriptions and, over the past decade, recorded almost no improvement. This is despite the fact that the Pacific subregion as a whole has the highest subscription rate, owing to the growth in and number of subscriptions in Australia and New Zealand. While French Polynesia, Fiji, New Caledonia and Tonga have experienced high growth in broadband connectivity, eight Pacific island countries are lagging behind, with less than 2 per cent of average fixed-broadband penetration.[1] Similarly, in East and North-East Asia, rapid expansion is mainly being driven by China, Japan and the Republic of Korea. In North and Central Asia, noticeable progress was observed mainly in Azerbaijan, Georgia, Kazakhstan, the Russian Federation and, recently, Uzbekistan.

[1] ESCAP, *Broadband Connectivity in Pacific Island Countries* (Bangkok, 2018).

Figure I

Average fixed-broadband subscriptions per 100 habitants, by ESCAP subregion, 2006, 2011 and 2016



Source: ESCAP calculations based on data from International Telecommunication Union (ITU), World Telecommunication/ICT Indicators database 2017 (21st Edition/December 2017); available at www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx (accessed 25 April 2018).

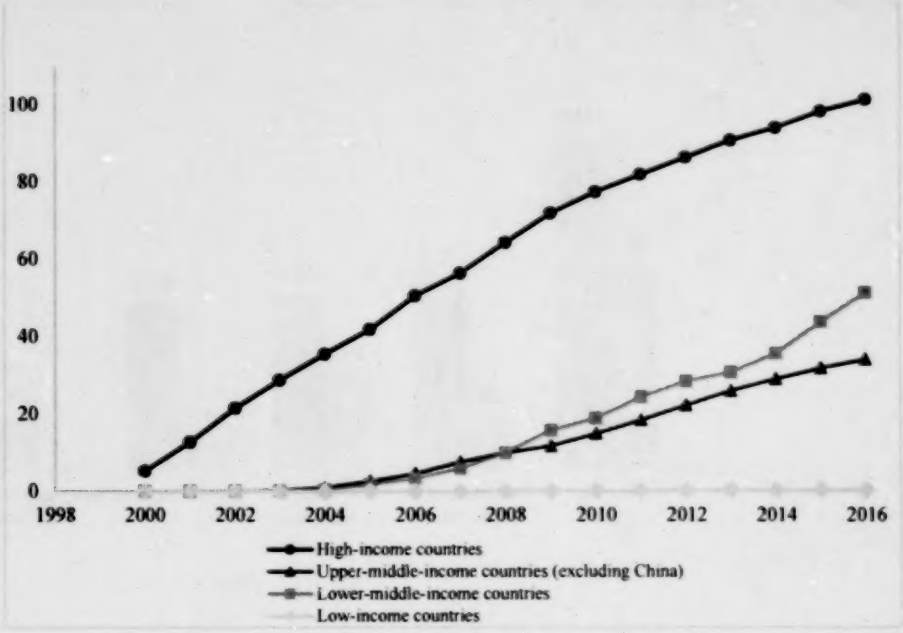
Note: The category entitled "Pacific developing countries" excludes Australia and New Zealand.

9. Using the standard deviation approach (a measure of sample distribution) to examine fixed-broadband connectivity, it is clear that there is similar evidence of a widening broadband divide in Asia and the Pacific.[2] Specifically, an estimate relating to Pacific island countries shows that in terms of fixed-broadband subscriptions, the standard deviation values increased between 2010 and 2016, meaning that the differences among countries, especially between countries with high and low broadband access, increased over time. The estimate also indicates that some countries have experienced no growth in broadband connectivity.

10. Countries of different income levels have experienced different growth patterns in fixed-broadband subscriptions, as shown in figure II. High-income economies have demonstrated stable but slow growth over the years, while upper- and lower-middle-income economies have demonstrated accelerated growth since 2007. The most worrisome trend is the lack of progress in the total number of fixed-broadband subscriptions among low-income economies, which is further worsening the broadband divide among countries.

[2] ESCAP, *Artificial Intelligence and Broadband Divide*.

Figure II
Fixed-broadband subscriptions per 100 inhabitants, by income group, 2007–2016



Source: ITU, World Telecommunication/ICT Indicators database 2017 (see figure I).

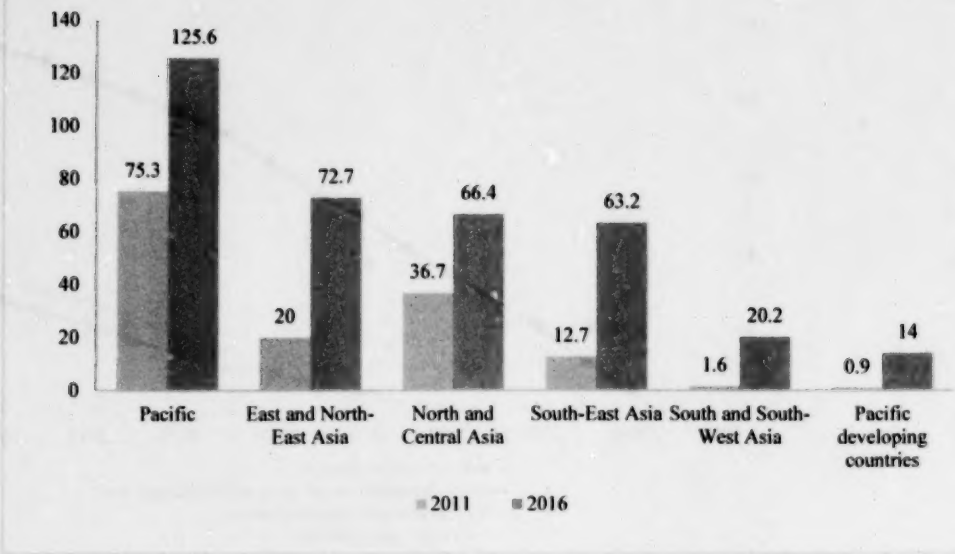
B. Mobile broadband

11. Asia and the Pacific performed much better in terms of mobile-broadband uptake.[3] The region is leading in mobile-broadband growth, with the majority of global mobile-broadband subscriptions registered in the region.

12. Figure III shows that the average number of mobile-broadband subscriptions per 100 inhabitants was highest in the Pacific (driven by Australia and New Zealand), followed by East and North-East Asia (driven by Japan and the Republic of Korea). There has been rapid expansion in many countries in North and Central Asia and South-East Asia. Among all the subregions, South and South-West Asia and developing countries in the Pacific had the lowest average mobile-broadband subscriptions per 100 inhabitants, although there have been significant increases in both subregions since 2011.

[3] Mobile broadband has many advantages: (a) it enables Internet access wherever and whenever required, with no fees to connect to fixed networks; (b) it does not require physical infrastructure to reach each home and does not require the purchase and rental of a landline; and (c) there are no set-up fees involved, making it a cost-efficient option compared to fixed (wired) broadband.

Figure III
Average mobile-broadband subscriptions per 100 habitants, by subregion, 2011 and 2016

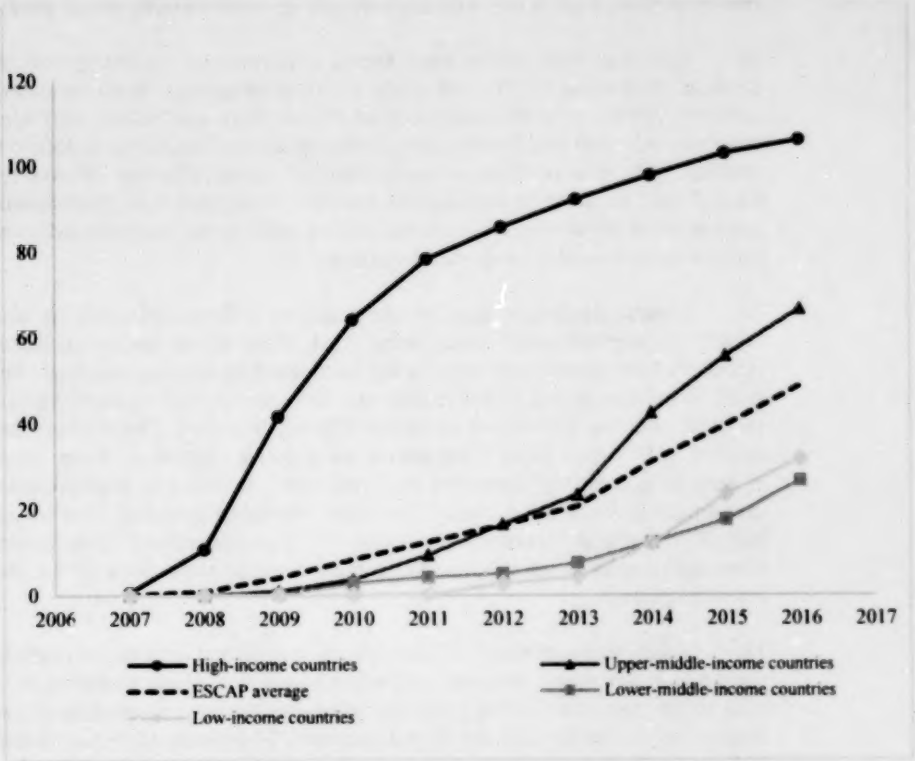


Source: ITU, World Telecommunication/ICT Indicators database 2017 (see figure I).

Note: The category entitled "Pacific developing countries" excludes Australia and New Zealand.

13. From figure IV, significant expansion can also be observed in mobile-broadband subscriptions across income groups. Low-income countries are quickly catching up, and even surpassing lower-middle-income countries. High-income countries show the highest subscription rate, but slower growth, likely owing to market maturity.

Figure IV
Mobile-broadband subscriptions per 100 inhabitants, by income group, 2007–2016



Source: ITU, World Telecommunication/ICT Indicators database 2017 (see figure I).

Note: The category entitled "Pacific developing countries" excludes Australia and New Zealand.

C. Broadband in countries with special needs

14. In *Artificial Intelligence and Broadband Divide*, another worrisome trend in the region is underlined: countries with special needs, such as small island developing States, the least developed countries and landlocked developing countries, registered slower progress than the rest.[4] Indeed, several of these countries had fewer than two fixed-broadband subscriptions per 100 inhabitants, with virtually no progress. Considering that 60 per cent of mobile data traffic was offloaded to fixed broadband through Wi-Fi and femtocells in 2016 – a proportion that, according to the above-mentioned report, is expected to increase to 63 per cent in 2021 – the importance of fixed-broadband infrastructure is accentuated not only at the backbone or backhaul level but also at the retail level. Furthermore, as stated in the report, the debate on the substitution effects of mobile broadband on fixed-broadband access is not conclusive, as some reports indicate that they are in fact complementary. Considering affordability, capacity, latency and reliability, mobile-broadband growth would require fixed-broadband infrastructure expansion.

[4] For the full list of countries, see ESCAP, *Artificial Intelligence and Broadband Divide*.

15. In the absence of robust fixed- and mobile-broadband networks and access, most people in countries with special needs do not benefit fully from the rapid advancements of digital technologies and the opportunities they offer. In order to combat disparities, it is necessary to investigate the main factors that are holding back broadband development in countries with special needs.

16. Countries with special needs appear to have mixed regulatory policies in place.[5] According to ITU data, while 13 countries reported that a regulatory authority for the telecommunications sector had been established, only nine countries indicated that the regulatory authority enjoyed autonomous decision-making. Only nine countries indicated that full competition was allowed for local fixed-line services and mobile services. Competition in international gateways was allowed in only seven countries, while seven countries indicated that a universal service fund was operational.

17. Special challenges faced by the countries with special needs are also related to geography and demography. Lack of access to the sea increases prices for international connectivity for landlocked developing countries. For small island developing States, market size and the size of the islands create a problem with the roll-out of terrestrial fibre-optic cables. These issues are exacerbated since some landlocked developing countries have large mountainous, sparsely populated and rural areas, resulting in higher capital investment and operation costs.[6] The least developed countries tend to lag behind developed countries in terms of fixed-broadband penetration, household access to information and communications technology (ICT), and Internet uptake.[7]

18. Additionally, the cost of electricity is considered as a major obstacle for the least developed countries and small island developing countries, as it adds to the cost of powering networks and raises the cost of broadband and Internet access. In the least developed countries, 79 per cent of the population lack access to electricity while 91 per cent have no access to modern fuels. The countries with the highest prices of electricity are in many cases small island developing States.[8]

III. Emerging technologies and the broadband divide in the region

19. The technological context surrounding ESCAP member countries has also been changing, with the introduction and roll-out of emerging technologies such as artificial intelligence. The accelerating adoption and proliferation of these technologies, some of which are bandwidth-intensive, will have a significant impact on the broadband networks and ecosystems, while the existing broadband divide is expected to constrain the roll-out of such applications and solutions. In this context, ESCAP undertook an analysis to identify the challenges and opportunities presented by artificial intelligence and its associated digital technologies, and how they could help support the

[5] Affordability and capacity also tend to vary among these countries.

[6] For a sample analysis of capital expenditure and operating expenditure, see ESCAP, *A Study of ICT Connectivity for the Belt and Road Initiative (BRI): Enhancing the Collaboration in China-Central Asia Corridor* (Bangkok, 2017).

[7] ITU, *ICTs, LDCs and the SDGs: Achieving Universal and Affordable Internet in the Least Developed Countries* (Geneva, 2018).

[8] Ibid.

achievement of the Sustainable Development Goals once all the factors are put in place.[9]

20. Cases of use of artificial intelligence in the agricultural sector include image recognition, data collection and analysis, and space technology applications, which help identify crop diseases onsite. The technologies may also help deliver accurate weather forecasts to guide farmers in making informed decisions on planting, harvesting, irrigation and use of fertilization. In health care, solutions powered by artificial intelligence have improved the accuracy and efficiency of diagnosis for a wide range of diseases, including cancers, and a number of applications that analyse medical images are being used to substitute and complement high-level but scarce medical expertise. In addition, artificial intelligence solutions have been increasingly used to enhance the region's resilience to disasters, particularly through real-time monitoring of hazards, assessment of risk, early warning and information support using the Internet of things, sensors and big data. These solutions and applications, enabled by artificial intelligence and digital technology, are expected to accelerate the implementation of the Sustainable Development Goals and bring qualitative transformations to both society and economy.

21. However, according to the ESCAP analysis report, not all countries in the region are equipped to develop and introduce such solutions. To reap the above-mentioned benefits, a number of conditions need to be put in place. The findings of the report suggest that the size of an economy matters in the uptake of artificial intelligence, meaning that countries with a bigger market size and thus larger workforce tend to produce more research and applications related to artificial intelligence. It is also pointed out in the analysis that a reliable and vibrant telecommunications sector correlates with artificial intelligence uptake. Furthermore, there is a strong positive correlation between artificial intelligence research and reliable and resilient broadband networks, which may demonstrate the necessity of the underlying broadband infrastructure for the development and uptake of artificial intelligence. In this context, developed economies with artificial intelligence capabilities and robust broadband infrastructure are expected to benefit more and grow wealthier than the rest, while the less developed economies of the least developed countries, landlocked developing countries and small island developing States are at risk of being further marginalized and left behind.

IV. Main challenges

22. ESCAP research and analyses also identified financial, institutional, policy-related, social and economic factors that may influence the expansion of broadband connectivity within and among ESCAP member countries. A summary of the key findings of these reports, categorized around the main factors, is given below.

Affordability

23. The affordability of broadband access is one of the key factors driving the broadband connectivity growth in the region. In an ESCAP study, the cost of fixed broadband in two of the nine countries surveyed – Kiribati and Solomon Islands – represented over half of the gross national income per capita, which was reflected in the slow broadband growth.[10] An ESCAP study on broadband networks in the Association of Southeast Asian Nations

[9] ESCAP, *Artificial Intelligence and Broadband Divide*.

[10] ESCAP, *Broadband Connectivity in Pacific Island Countries*.

(ASEAN) subregion also found a similar result: the costs of subscriptions in the Lao People's Democratic Republic and Myanmar were more than 15 per cent of the gross national income per capita, and much more than 10 per cent in Cambodia and Indonesia, correlating with the level of broadband access and growth rates respectively.[11] A report on the ASEAN subregion also found that lack of diversity in ICT network routes, limited competition and cost of access to global networks, including via submarine cables, may influence the cost passed on to end users.[12]

E-resilience

24. Broadband networks can often be disrupted by natural disasters. As such, the challenge is to enhance the resilience of ICT infrastructure and its ability to support disaster-response efforts efficiently and effectively. When applied specifically to ICT, resilience relates to two dimensions: (a) ICT for disaster response and recovery, including the rapid restoration of ICT infrastructure and services; and (b) ICT for disaster risk prevention, risk reduction and preparedness.

25. The Asia-Pacific region is the most disaster-prone region in the world, with frequently occurring natural disasters including earthquakes, tsunamis, tropical storms, flooding, landslides and volcanic eruptions. Data from 2016 show that there was a lower impact of disasters in the region by historical standards, and yet 4,987 people were killed, 34.5 million people were affected and physical damage was estimated to have cost approximately $77 billion.[13] Among the effects, the economic impact is greatest in the least developed countries and small island developing countries. Post-disaster needs assessment reports for some disaster events underlined the destructive effects of natural disasters on ICT infrastructure and facilities, which in turn negatively affected emergency response efforts. Frequent disasters in the region not only disrupt broadband networks but also derail broadband-expansion efforts and infrastructure investment in the region, which could further exacerbate the broadband divide in the region.

Quality of regulation

26. Poor quality of regulations is strongly correlated with low ICT connectivity and vice versa in ESCAP countries and globally.[14] Historically, the telecommunications industry has been operated and controlled by monopolies owing to high start-up capital requirements, which often led to inefficient and costly services. Targeted policy interventions and regulatory reforms have been effective in stimulating the growth of the telecommunications sector. For example, a strong and independent judiciary system, an independent telecommunications regulator and high-quality regulatory bureaucracy seem to correlate positively with the level of competition and private investment in ICT infrastructure, which overall leads

[11] ITU, *Measuring the Information Society Report 2017*, vol. 2, *ICT Country Profiles* (Geneva, 2017).

[12] ESCAP and National Information Society Agency, *Technical Report: A Pre-feasibility Study on the Asia-Pacific Information Superhighway in the ASEAN Sub-region – Conceptualization, International Traffic and Quality Analysis, Network Topology Design and Implementation Model* (Bangkok, 2016).

[13] *Leave No One Behind: Disaster Resilience for Sustainable Development – Asia-Pacific Disaster Report 2017* (United Nations publication, Sales No. E.17.II.F.16).

[14] ESCAP, *State of ICT in Asia and the Pacific 2016: Uncovering the Widening Broadband Divide* (Bangkok, 2016).

to better performance in the telecommunications industry. An ESCAP study on Pacific island countries provides concrete evidence in this regard: the regulatory reforms in the telecommunications sector allowed private operators to enter the market, which has driven competition and led to a significant expansion of mobile-broadband access and service.[15]

27. Lack of competitive markets may be a problem in some countries. The liberalization of international gateways correlates with broadband expansion.[16] However, owing partly to rising security concerns, the number of countries liberalizing the international gateways appears to be reducing in the region.

Gaps in capacities and skills

28. While broadband diffusion and technological innovations may create vast opportunities for society, they also come with potential negative consequences when the pace of the diffusion is not matched with sufficient capacity and skills. This issue is of particular relevance to the Asia-Pacific region, where approximately 60 per cent of the world's youth population resides.[17] Microsoft conducted a survey among youth in 14 markets in the Asia-Pacific region and found that young people in the region expected technology applications such as artificial intelligence to have the largest impact on their future lives.[18] However, 6 out of 10 young people felt that their countries were not ready to adapt to digital disruptions, highlighting the need for access to technology as a key priority. In many developing countries, Governments tend to channel relatively few resources and insufficient effort into supporting capacity development initiatives in public and private institutions. Thus, the benefits of ICT – which could be a great source of technological leverage, innovation and capacity development – go unrealized.

29. The International Data Corporation predicted that 8.6 billion devices driven by the Internet of things would be used in Asia and the Pacific (excluding Japan) by the year 2020. However, having the required human capital to match the rapidly growing demand for new technology-related skills is a major challenge.[19] In a CompTIA report, significant skills gaps are identified in the areas of artificial intelligence, business-process automation and the Internet of things.[20] The skills gaps occurred both in new hire and the existing workforce, who lacked advanced skills in the following areas: integration of different applications, data sources, platforms and devices; cloud infrastructure and cloud application skills; digital business transformation or skills for modernizing legacy hardware or software; and cybersecurity.[21]

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[15] ESCAP, *Broadband Connectivity in Pacific Island Countries*.

[16] ESCAP, "Effect of open international gateways on the broadband connectivity market" (Bangkok, 2017).

[17] *Switched On: Youth at the Heart of Sustainable Development in Asia and the Pacific* (ST/ESCAP/2744).

[18] Microsoft, "Asia-Pacific youth expect artificial intelligence to have biggest impact on their future: Microsoft survey", 22 February 2017.

[19] ESCAP, *Internet of People* (forthcoming).

[20] CompTIA, "Assessing the IT skills gap", May 2017. Available at www.comptia.org/resources/assessing-the-it-skills-gap.

[21] David Weldon, "AI, business process automation the hardest skills to find", Information Management, 23 June 2017. Available at www.information-management.com/news/artificial-intelligence-automation-the-hardest-skills-to-find.

30. Furthermore, recent ESCAP studies on institutions of higher learning revealed that curricula and programmes at universities in Asia-Pacific countries may not be updated to take advantage of emerging technologies and develop necessary and relevant human capacities.[22] To address these skills challenges, targeted support is urgently needed to provide sufficient infrastructure, especially in primary and secondary schools, as well as universities and research institutes with science, technology, engineering and mathematics programmes. These programmes have become a foundation and prerequisite in developing relevant and sufficient skills for the application of emerging technologies.

31. Such needs for skills upgrade and capacity development are particularly acute when solutions enabled by artificial intelligence are introduced. Low-skilled and labour-intensive jobs may be vulnerable to automation and artificial-intelligence-assisted services, but systematic support in training and skills development could create new employment opportunities with value added.[23]

Widening gender gap

32. There are increased concerns as to whether emerging technologies will deepen gender bias. Broadband connectivity and its affordability are requirements for technological access and usage, and therefore the first factor influencing women's presence. Wage and income inequality between women and men is identified in ESCAP research as a factor that negatively influences the differentiated level of affordability and access to ICT tools and services between women and men. Even when women are connected to the Internet, other factors can affect their active participation, including digital literacy, the existence of relevant online content and other normative values. For example, in a study on women's perceived barriers to using the Internet, the World Wide Web Foundation found that "not knowing how" was an important reason cited by women from poor backgrounds with little or no education. Women were 1.6 times more likely than men to report a lack of skills as a barrier.[24] Given the gender disparity in education and skills in ICT, frontier technology applications like artificial intelligence may exacerbate the digital gender gap and accentuate other social biases.

Limited ICT investment and financing

33. Some Governments have established universal access and service funds as a funding mechanism to stimulate the development of ICT infrastructure, especially in unserved and underserved areas.[25] These funds, by their function,

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[22] ESCAP, "Planning processes, policies and initiatives in ICTD education at institutions of higher learning (IHLs) in Asia and the Pacific", 27 January 2017. Available at www.unescap.org/resources/planning-processes-policies-and-initiatives-ictd-education-institutions-higher-learning.

[23] ESCAP, *Artificial Intelligence and Broadband Divide*.

[24] ESCAP, *Social Media and Gender* (forthcoming); and World Wide Web Foundation, *Global Report – October 2015: Women's Rights Online – Translating Access into Empowerment* (Washington, D.C., 2015).

[25] The universal access and service fund is a financing mechanism established by national Governments to connect sparsely populated rural areas, where there is neither the population density nor the capital for telecommunications operators to justify private sector infrastructure investments. Initially, the focus of the funds was on providing basic telecommunications services, such as fixed telephones, to unserved and underserved areas. However, as countries have formulated their national

could provide affordable and accessible broadband connectivity, which serves as a foundation for the creation, adoption and usage of applications and services, in turn leading to more users and more demand for ICT services.

34. However, a recent ESCAP study demonstrates that the effectiveness of universal access and service funds in delivering their core promises is debatable.[26] The results of country case studies and econometric analysis indicate that countries with universal access and service funds targeting the expansion of broadband and Internet have not experienced better outcomes in fixed-broadband and Internet growth than countries without such funds. This limit in the effectiveness of the funds is possibly because of weaknesses in the design, structure and implementation, which hamper the timely and efficient disbursement of funds.

Privacy

35. In the age of big data, the massive amounts of personal data generated, collected, sold and traded by third parties, along with the proliferation of mobile devices, sensors and social networking platforms, have become a challenge globally. In particular, the privacy of individuals is reduced when smart devices are constantly collecting and analysing data and information from their use without the full understanding, awareness and consent of users.[27]

Limited co-deployment

36. Co-deployment, or simultaneous deployment of ducts and/or fibre-optic cable along critical infrastructure during its construction, could lead to a significant reduction of time and costs in the development of broadband infrastructure. A forthcoming ESCAP study finds that co-deployment can save $7,379 per kilometre, or 56.83 per cent of total costs, compared to separate fibre and highway deployment, based on a case study in Cambodia and Myanmar.[28] Co-deployment has also been implemented in Bangladesh and India along critical infrastructure, while a number of other countries have included co-deployment in the design of future infrastructure deployment. Positive examples from projects already implemented in the region can serve as a guide for ESCAP member countries to improve broadband connectivity through co-deployment.

The need for national broadband ecosystems

37. China, Japan and the Republic of Korea present models with advanced broadband networks and widespread broadband access, enabled by progressive broadband policies, regulations, initiatives and investment, constituting the national broadband ecosystem. An ESCAP report contains an analysis of success factors among the three countries, which have developed different

broadband strategies, the role of the funds has shifted towards building broadband infrastructure and providing universal broadband access.

[26] ESCAP, *The Impact of Universal Service Funds on Fixed-broadband Deployment and Internet Adoption in Asia and the Pacific* (Bangkok, 2017).

[27] ESCAP is planning to produce a working paper on cyberattacks and cybersecurity.

[28] ESCAP, National Information Society Agency (Republic of Korea) and KT (Korea Telecom), *A Study on Cost-benefit Analysis of Fibre-optic Co-deployment with the Asian Highway* (forthcoming).

models and approaches to broadband expansion and enhanced e-resilience.[29]

38. In this context, a way forward for the region could include examining various elements of the national broadband ecosystem models and approaches developed by China, Japan and the Republic of Korea in creating strong regulatory bodies. They facilitate the complex process of mediating all stakeholders' requirements while expanding last-mile connectivity and enhancing e-resilience. Examples from Bangladesh, India and Myanmar have shown that co-deployment is possible and has been practised for some time. In addition, co-deployment presents an opportunity to reduce the costs of broadband development through collaboration with the authorities responsible for highways and other utilities. A next step could be to extend the model to cross-border co-deployment to ensure seamless connectivity in Asia and the Pacific.

39. All these conditions will not be possible unless multi-stakeholder cooperation and collaboration are put in place among Governments, the private sector, academia and civil society. Cooperation and collaboration should take place not only at the national level but also at the regional and global levels. In this context, regional and global cooperation platforms, such as that offered by the Asia-Pacific Information Superhighway initiative, could be particularly important in addressing challenges and identifying common solutions and approaches in Asia and the Pacific.

V. Issues for consideration by the Committee

40. The findings described in the present document are aimed at informing policymakers in ESCAP member countries and stakeholders in support of the implementation of the Master Plan for the Asia-Pacific Information Superhighway and the Asia-Pacific Information Superhighway Regional Cooperation Framework Document as applicable. At the same time, they relate to concrete policy challenges for the attention of the Committee. In this regard, the Committee may wish to review the below policy recommendations and provide guidance to the secretariat on its future programme direction:

(a) The Committee may wish to consider prioritizing investment in and support for the development of broadband connectivity and ecosystems as an urgent development priority, given the development and roll-out of emerging technologies, such as artificial intelligence and its associated digital technologies;

(b) The Committee may wish to consider providing targeted support to bridge the broadband divide among countries with special needs, in particular the ESCAP member States with special needs that have been identified as having made the slowest progress in broadband expansion;

(c) In view of the proliferation of emerging technologies, the need for enhanced e-resilience and the persistent broadband divide within and between countries, the Committee may wish to undertake a review of ICT policies and regulations, taking into account the various elements identified in national broadband ecosystem models and the institutional and financing factors mentioned in ESCAP studies;

(d) The Committee may wish to note the urgent need for strengthened capacity-building and skills development programmes to ensure

[29] ESCAP, *E-resilience: A Review of National Broadband Policies, Regulations, Strategies and Initiatives of China, Japan and the Republic of Korea* (forthcoming).

that that there is a sufficient supply of human capital to meet the rapidly growing demand for skills related to emerging technologies, and propose that such programmes be expanded through, inter alia, the Asian and Pacific Training Centre for Information and Communication Technology for Development;

(e) The Committee may wish to consider strengthening collaboration with the relevant sectors, such as the transport and energy sectors, to minimize costs through the co-deployment of fibre-optic cables along passive infrastructure such as the Asian Highway and Trans-Asian Railway networks and cross-border power grids and pipelines;

(f) The Committee may wish to further encourage expanded cooperation and partnerships at the regional, national and subnational levels to promote policy-related dialogues and the sharing of experience and good practices, which would leverage synergies and reap new opportunities to address the existing and emerging challenges stemming from the rapid advancement of technology, within the context of the Asia-Pacific Information Superhighway initiative.

United Nations ESCAP/CICTSTI/2018/4

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Committee on Information and Communications Technology, Science, Technology and Innovation

Second session
Bangkok, 29–31 August 2018
Item 3 (b) of the provisional agenda*
Policy issues for information and communications technology: enhancing space applications in Asia and the Pacific for the implementation of the Sustainable Development Goals

Enhancing space applications in Asia and the Pacific for the implementation of the Sustainable Development Goals

Note by the secretariat

Summary

Improved data, information and knowledge will be critical for the implementation, follow-up and review of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals. Space applications, geospatial services and their digitization have rapidly evolved in the past years with the potential to provide far-reaching solutions to pressing issues facing humanity, ranging from health, education, food security, agriculture, climate change, energy and natural resources management to disaster risk reduction and resilience-building.

For close to two decades, the Economic and Social Commission for Asia and the Pacific (ESCAP) has provided a regional platform that, in tandem with technological advances, has progressively promoted the use of space applications and geospatial information for sustainable development across the region. In alignment with this ESCAP approach, an ever increasing number of developing countries are using space applications for sustainable development in the region.

The adoption of the 2030 Agenda has offered the space community a unique opportunity to scale up the use of space applications and derived geospatial information across the region. With the completion of the Asia-Pacific Plan of Action for Applications of Space Technology and Geographic Information Systems for Disaster Risk Reduction and Sustainable Development, 2012–2017, ESCAP is working with member States to formulate a new Asia-Pacific plan of action on space applications for sustainable development (2018–2030). The objective is to enable space applications and geospatial information services to contribute to the fullest extent to efforts to achieve the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific and to support country and regional needs in relation to the 2030 Agenda. The new action plan will encompass and define a concept entitled "Space+".

* ESCAP/CICTSTI/2018/L.1.

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The present document contains a brief review of emerging best practice in the Asia-Pacific region as well as the challenges to be addressed. It also contains information on the preparatory process leading up to the third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, which will be held on 10 October 2018. The Committee on Information and Communications Technology, Science, Technology and Innovation is requested to provide guidance on the future direction of the secretariat's regional work and on how best to leverage geospatial information, applications and services through the new regional action plan under preparation, in support of sustainable development.

The Committee may wish to discuss the issues raised in the document and propose policy action to promote the utilization of geospatial information services for sustainable economic and social development.

I. Achieving the Sustainable Development Goals through enhanced regional cooperation

1. Space applications, geospatial services and their digitization have rapidly evolved in the past years, providing an ever expanding array of tools for a more sustainable future. They have been recognized as innovative technologies in supporting the implementation of the global development agendas, including the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Paris Agreement. They can provide far-reaching solutions to pressing issues facing humanity, ranging from health, education, food security, agriculture, climate change, energy and natural resources management to disaster risk reduction and resilience-building, by enhancing information for evidence-based decision-making.

2. The Economic and Social Commission for Asia and the Pacific (ESCAP) has a well-established track record in this area, having established its Regional Space Applications Programme for Sustainable Development over twenty years ago. More recently, it has been placing renewed emphasis on the importance of countries being able to monitor and measure high-quality, timely, reliable and accurate data, including Earth-observation and geospatial information, to address the challenge of leaving no one behind. The work is well grounded in the ESCAP intergovernmental process.

3. Notably, the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific,[1] which the Commission endorsed in its resolution 73/9, contains references to ways in which regional cooperation on technology can be enhanced to support the implementation of the Sustainable Development Goals.

4. Furthermore, the Asia-Pacific Space Leaders Forum, which was held in New Delhi on 2 November 2016, highlighted the role of space applications in the implementation of the Sustainable Development Goals and expressed support for the preparation by the secretariat of a new Asia-Pacific plan of action on space applications for sustainable development (2018–2030) for adoption at the third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific.

5. Consequently, the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development at its twenty-first session, held in October 2017, agreed on an ambitious vision for the plan of action: that, by 2030, all countries in the Asia-Pacific region would

[1] E/ESCAP/73/31, annex II.

be able to access and use space science, technology and their applications to the fullest extent to meet their individual and regional needs for achieving the Sustainable Development Goals.[2]

6. A drafting committee was set up and, under the chairmanship of the representative of Thailand and the vice-chairmanship of the representative of Sri Lanka, met at the end of May 2018 to draft the plan of action. Further details are provided in section IV below.

7. Over and above this process, since 2017, ESCAP, in collaboration with spacefaring countries in the region, has continued to provide timely services and support on space-derived data and products to countries affected by severe disasters. Over the past decade, an average of more than 400 high-resolution satellite images and products have been provided annually to disaster-affected developing countries for damage assessment, from disasters that include drought, cyclones, earthquakes and floods. There are now over 150 experts in member countries of the Regional Space Applications Programme for Sustainable Development directly involved in this continuously available service and support. In-kind contributions of free data and services worth more than $1 million are estimated to have been provided by ESCAP member States, through the Regional Space Applications Programme, to countries affected by disasters.

8. With the advances that have been made in space applications, countries require not only better technology, tools and infrastructure, but also the human capacity to operate the systems. Many developing countries, including small island developing States, may not have sufficient human resources and experts to fully take advantage of these innovative technologies. Through the Regional Space Applications Programme, as well as regional partnerships, countries can strengthen their human resources base.

9. In this regard, the Regional Cooperative Mechanism for Drought Monitoring and Early Warning serves as one example of a substantive operational platform of the Regional Space Applications Programme. The Regional Cooperative Mechanism has created a series of information tools and other service products to support drought-prone developing countries in a customized, situation-specific way, delivered in-country through capacity development activities.

10. Specifically, the Regional Cooperative Mechanism, through its regional service nodes in China, India and Thailand, has been providing customized technical support to enhance the use of Earth-observation data for drought monitoring and assessments, and has thereby helped build long-term human and institutional capacity. The recent operationalization of the drought monitoring system in Myanmar has significantly improved the drought-monitoring capability by providing agricultural drought information in terms of its prevalence, severity and persistence using moderate resolution data.[3] Multiple indices were used for drought assessment, ground databases were augmented and synergy between ground observations and satellite-based interpretation were strengthened. Through this process, both the user-friendliness and the frequency of information dissemination were enhanced. Similarly, the drought monitoring system operationalized in Mongolia uses

[2] For the summary meeting report, see www.unescap.org/sites/default/files/E_ESCAP_ICC%2821%29_9_SummaryReport_REV.pdf.

[3] This drought monitoring system was customized using the one developed by the National Remote Sensing Centre of the Indian Space Research Organization.

space-referenced and ground-based data that synthesize various drought indices,[4] thus offering crucial baseline data against which to issue early warnings for the *dzud*.[5] By deepening the understanding of disaster risk and its dynamic components, more context on the progress of the *dzud* and the resulting damages for nomadic herders has been provided for decision-making by policymakers.

11. Since 2016, and with sponsorship from the Government of Japan and technical support from the Indonesian Agency for Meteorology, Climatology and Geophysics and the Asian Institute of Technology, ESCAP has been assisting Pacific island countries to strengthen institutional capacities in the use of geospatial data and to build national geoportals as key components of multi-hazard early warning systems for extreme weather-related disasters.[6] The Common Alerting Protocol, a digital format for exchanging emergency alerts in an internationally standardized format, has been implemented in Solomon Islands[7] and Tonga. National meteorological services authorities in these countries are now able to make weather predictions available with a resolution of 2.3 kilometres, compared to 25 kilometres previously. The drought monitoring system in Papua New Guinea, which was established with support from the Indonesian Agency for Meteorology, Climatology and Geophysics and ESCAP, has enabled forecasts of consecutive dry days, dry and wet spells and monthly rainfall. The predictions are disseminated online through the official website of the National Weather Service.[8] Similarly, in Solomon Islands, the accuracy of predictions on ocean conditions and tropical cyclones has been improved using images with a resolution of 7 kilometres. Another example shows that when Cyclone Gita, an intense tropical cyclone, hit Tonga in February 2018, geoportal and numerical weather prediction models enabled a precise and impact-based forecast, averting a disaster with potentially catastrophic impacts through greater preparedness and with the timely evacuation of communities.

12. Additionally, the secretariat has been working closely with the secretariat of the Association of Southeast Asian Nations (ASEAN) to implement activities in the subregion given its high disaster risk profile. An ongoing ESCAP-ASEAN joint study on drought capitalizes on knowledge-based space applications to promote risk-sensitive policies and interventions based on drought monitoring and assessments, both in-season and in the long-term. Its aim is to highlight three types of evidence-based policy intervention: strengthening drought risk assessment, impact-based forecasting and early

[4] This drought monitoring system was customized using the one developed by the Institute of Remote Sensing and Digital Earth of China.

[5] The *dzud* is a phenomenon of drought that leads to inadequate pasture, severely affecting the livelihood of herding-based nomads, followed by severe winter that kills much of their already enfeebled livestock.

[6] For further information on training and workshops held as part of the ESCAP project entitled "Strengthening multi-hazard risk assessment and early warning systems with applications of space and geographic information systems in Pacific island countries", see www.unescap.org/events/first-pacific-regional-workshop-multi-hazard-risk-assessment-and-early-warning-systems, www.unescap.org/events/training-national-geo-database-and-geo-portal-drr-and-sustainable-development, www.unescap.org/events/1st-expert-group-meeting-pacific-strategy-knowledge-hub-early-warning-system and www.unescap.org/events/training-national-multi-hazards-early-warning-systems-geo-spatial-applications-disaster-risk.

[7] See https://smartalert.met.gov.sb.

[8] www.pngmet.gov.pg/Climate_Division.

warning; fostering the development of drought risk financing; and promoting a culture of prevention by enhancing adaptive capacity to drought.

13. Addressing gaps in human skills remains a key challenge, particularly in countries in the region that have high disaster risk and low capacity. The secretariat continued to address this need, through a number of customized training programmes implemented in partnership with countries that have high capacity. For example, in late 2017, the secretariat in collaboration with the Korea International Cooperation Agency conducted capacity-building on spatial data and technologies for urban planning and disaster management for Central Asian countries such as Kyrgyzstan, Tajikistan and Uzbekistan. In 2018, the secretariat provided sponsorship for young technicians from Bangladesh, Mongolia, Myanmar and Tajikistan to take master's degree courses on remote sensing and geographic information systems (GIS), with full scholarship from the Government of India, at the Centre for Space Science and Technology Education in Asia and the Pacific.[9] Similarly, under a memorandum of agreement between ESCAP, the South-South Education Foundation and the Chinese University of Hong Kong, two junior government officials from Papua New Guinea and Sri Lanka will soon be joining the master's degree course on geospatial information applications at the Institute of Space and Earth Information Science of the Chinese University of Hong Kong, with full scholarship provided by the South-South Education Foundation. In addition, collaboration with the ASEAN Research and Training Centre for Space Technology and Applications will focus on research and knowledge-sharing for ASEAN countries in disaster risk reduction, environment and agriculture development.

14. Sharing knowledge products and best practice will be critical to developing countries for the effective application of geospatial information. In this connection, the launch of a biennial Asia-Pacific report on geospatial information applications for sustainable development, as well as an online compendium of regional geospatial information services, is under consideration by the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development, with the aim of enhancing research and knowledge-sharing on capacity development and emerging trends in innovation in geospatial information applications.

II. Good practice

15. As compared to the early 1990s when the Regional Space Applications Programme for Sustainable Development was set up, there is a growing body of good practice on space applications for sustainable development emerging from developing countries in the Asia-Pacific region. Increasingly, countries are effectively integrating space applications, Earth-observation data and geospatial data, and combining such outcomes with statistical and demographic data, for near real-time analysis of conditions and modelling of complex and dynamic risk scenarios. Digital maps and other visualizations are particularly useful for supporting the evaluation of impacts across sectors and regions and allowing change over time to be monitored in a more consistent and standardized manner. The result is improved decisions, policy and accountability. These outcomes are beginning to have a transformational impact on many of humanity's most significant challenges in the developing

[9] The Centre for Space Science and Technology Education in Asia and the Pacific is affiliated to the United Nations and hosted by the Government of India (Department of Space) in Dehradun, India.

world, improving the ability of global scientists, resource and planning managers and politicians to monitor and protect fragile ecosystems, ensure resilient infrastructure, manage climate risks, enhance food security, build more resilient cities, reduce poverty and improve governance. The sections below illustrate this potential through selected examples of country practice in Asia and the Pacific.

A. Space applications for disaster risk reduction and resilience

16. The Asia-Pacific region is the most disaster-prone region in the world. Since 2005, the region has recorded over 60 per cent of total global deaths, 80 per cent of affected people and 45 per cent of total economic damages due to disasters. [10] This situation is a result of rapid economic growth and population expansion. Combined with the impact of climate change, over the coming decade, the region is expected to become increasingly vulnerable to disasters. Disasters within the region are also becoming more complex, often affecting multiple countries at once and sometimes cascading into multiple catastrophes. Disasters such as floods, droughts, tropical cyclones, earthquakes, tsunamis, and sand and dust storms are increasingly transboundary in nature, making them difficult to manage. With the advancement of technical innovations, space technology and geospatial data have emerged as strong tools to analyse disaster risks, enhance detection and prediction, and support recovery and rehabilitation from disaster damages while enhancing resilience.

17. The Geo-Informatics and Space Technology Development Agency of Thailand has used geospatial data through space applications to create an open-source platform of high-level, data-driven monitoring systems. These systems utilize a combination of Earth-observation imagery, GIS data and national disaster surveys embedded into a web map service. The four main monitoring systems cover floods, wildfire, drought and coastal radar. These systems work as a data-sharing mechanism which combine satellite imagery, geospatial data, spatial models and thematic processing for the use of policymakers, crisis managers and governors in decision-making.

18. The deployment of GIS-based safety map services by the Government of the Republic of Korea since 2014 has helped elevate attention to disaster situations. This service has been made available to 229 municipalities through a safety information integration system, giving people access to safety information through multiple media platforms such as computers and mobile phones, to identify location-based disaster risks and information such as the degree of risk of landslides and floods, coastal flooding forecast, and landslide and earthquake history.

19. Advanced emergency communication systems using geospatial services in China is another good example. The emergency satellite communication system in China has provided important support in disaster situations, including in the fight against floods and droughts, by helping efforts with respect to search and rescue, relief work and major emergencies. The BeiDou Navigation Satellite System has significantly improved the accuracy and reliability of data, and has been widely used in forest-fire prevention,

[10] E/ESCAP/73/31, annex II.

disaster reduction and relief, and emergency rescue, as well as hydrological monitoring, weather forecasting, surveying and mapping.[11]

B. Space applications for climate change

20. The Asia-Pacific region is already experiencing the negative effects of climate change, with higher temperatures, a rise in sea level and an increase in extreme weather events. In the coming years, these events are likely to intensify, straining regional economies and natural and physical assets and potentially compounding development challenges.[12] Given that all livelihoods, nutrition and economic opportunities depend on utilizing the terrestrial and marine resources and ecosystems of the planet, coordinated policy action across the region is needed.

21. Space applications can contribute to achieving the goals set out in the United Nations Framework Convention on Climate Change, the Paris Agreement and the 2030 Agenda. In endorsing the New Delhi Declaration, adopted by the Asian Ministerial Conference on Disaster Risk Reduction in 2016, space agencies acknowledged the need to coordinate their methods and their data to monitor human-induced greenhouse gas emissions.[13] In developing countries, remote sensing may offer important insight into urban and environmental conditions that are currently not available through traditional sources of governmental and private sector data. This collected data can support land-use monitoring and ecosystem changes, urban developments, ocean cycles and air-quality developments.

22. A number of countries are already incorporating space applications into their climate response strategies. For example, in the Bangladesh Climate Change Strategy and Action Plan 2009, emphasis is placed on geospatial applications using satellite technology by developing an understandable early warning and forecasting system that helps minimize risk to lives and properties by improving the prediction and accuracy of cyclones tracking and flooding.[14] Similarly, the Department of Meteorology of Sri Lanka is developing downscaled high-resolution climate change scenarios for specific regions by combining models provided by the Met Office Hadley Centre of the United Kingdom of Great Britain and Northern Ireland, including the "Hadley Centre Coupled Model" and the regional climate model from the "Providing Regional Climates for Impacts Studies" system. To improve its weather forecasting capability, the Department of Meteorology is also using receiving stations for data from geostationary weather satellites, and is receiving imagery and data from Meteosat, the Moderate-resolution Imaging Spectroradiometer, the Advanced Scatterometer and Oceansat to analyse the various weather and climate impacts.

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[11] China, State Council Information Office, "China's space activities in 2016", 27 December 2016. Available at www.scio.gov.cn/wz/Document/1537091/1537091.htm.

[12] E/ESCAP/73/31, annex II.

[13] Indian Space Research Organization, "World's space agencies unite to face the climate challenge", 3 June 2016.

[14] Office for Outer Space Affairs and National Institute of Aeronautics and Space of Indonesia, "United Nations/Indonesia International Conference on Integrated Space Technology Applications to Climate Change: abstracts" (Jakarta, 2013). Available at www.unoosa.org/documents/pdf/psa/activities/2013/Indonesia/Indonesia_Abstracts.pdf.

C. Space applications for management of natural resources

23. Improved management of natural resources and the protection of ecosystems is a key priority in the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific. Currently, the Asia-Pacific region consumes more than half of the world's natural resources with increasing rates of absolute resource use and increasing resource use per person.[15] Through the use of space applications, large scale spatial data can be used to support conservation and sustainable management of resources.

24. The Global Mangrove Watch, established under the science programme of the Japan Aerospace Exploration Agency, provides geospatial information about mangrove extent and changes.[16] Space applications using satellite data can be used as tools to facilitate periodic monitoring of mangroves over large areas. Key Earth-observation sensors that use the Japan Aerospace Exploration Agency's series of satellites equipped with synthetic aperture radars provide suitable data for regular monitoring and change detection in cloud-prone coastal regions. This data coupled with other optical and digital elevation data provide annual global mosaics at a resolution of 25 metres for national wetland practitioners and decision makers as well as non-governmental organizations.[17]

25. Spatial modelling for natural and environmental vulnerability through remote sensing and GIS technologies was undertaken in Astrakhan, Russian Federation, by Samara State Aerospace University, American Sentinel University and Hokkaido University. It used multiple thematic layers with multidisciplinary approaches to observe the changes in land use/cover and vulnerability over the past 15 years. The results show that large parts of the area had moderate vulnerability (54.62 per cent), and that the increase in vulnerable land was due to population growth, increased deforestation, conversion of farmland to built-up areas, road expansion and uncontrolled grazing activities.[18] With the help of geospatial technologies, the Governments and policymakers were able to identify vulnerable areas that needed environmental recovery, rehabilitation and protection.

26. In Turkey, precision agriculture practices are being developed to analyse wheat, corn and cotton crops by using multispectral satellite imagery and aerial data. Ground measurements will also be collected to analyse the data in a geographic information system. This work is under the Hassa project, whose aim is to study the development of precision agricultural practices within the region covered by the South-Eastern Anatolia Project, to help improve the efficiency of farms and enhance production by reducing input such as water, fertilizer and pesticides into the agricultural land.

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[15] E/ESCAP/73/31, annex II.

[16] Group on Earth Observations, *Earth Observations in Support of the 2030 Agenda for Sustainable Development* (Tokyo, Japan Aerospace Exploration Agency, 2017).

[17] Ibid.

[18] Komal Choudhary, Mukesh Singh Boori and Alexander Kupriyanov, "Spatial modelling for natural and environmental vulnerability through remote sensing and GIS in Astrakhan, Russia", *Egyptian Journal of Remote Sensing and Space Science* (May 2017). Available at www.sciencedirect.com/science/article/pii/S1110982317302120?via%3Dihub.

D. Space applications for connectivity for the 2030 Agenda for Sustainable Development

27. Space technology applications and geospatial data are a key component for optimizing the expansion and integration of infrastructure such as highways, railways, dry port networks and digital connections, which make connectivity more inclusive and spread the benefits extensively to marginalized people. Improvements in regional connectivity in terms of transport, information and communications technology and trade will help boost economic growth.[19]

28. To improve connectivity within South Asia, work on the China-Pakistan Economic Corridor is under way, with a view to expanding economic opportunities through trade and infrastructure. Geospatial technologies have been used to determine the viability of the highway network through three key aspects: (a) vulnerability of the highway trade route to violence and threats; (b) the number of people living in close proximity to the trade route; and (c) the extent to which emerging economic regions in Pakistan will be connected via the trade route. The second aspect was calculated using geospatial statistics such as zonal statistics, and it was found that 25 per cent or more of the population lived within a 5-kilometre radius of the highway network and that in almost all regions more than 80 per cent of the population lived within a 50-kilometre radius, indicating that the route provides connectivity to the majority of the population in Pakistan. With regard to the third aspect, it was found that 85 per cent of areas that had experienced growth of between 0 and 50 per cent from 1993 to 2013 were within a 10-kilometre radius of the trade route, making the highway network a viable location for economic growth.[20]

29. One of the key components of the initiative by the Government of the Russian Federation to build a "Great Eurasian Partnership", towards sustainable economic growth in the region, is the deployment of intelligent transport systems using the Global Navigation Satellite System. The Government implemented regulations on the mandatory installation of the Global Navigation Satellite System in every new vehicle sold from 2017 for road tracking. By applying this system, it provides real-time tracking on deliveries and shipments, with a view to streamlining regulations, promoting competition and encouraging entrepreneurship to support growth.[21]

30. In New Caledonia, work is under way towards including the Sustainable Development Goals in local policy and planning, and 48 baseline indicators have been selected for reporting. Through space applications, namely GIS and remote sensing, the Government has created a geoportal to share, view and download imagery, data and metadata to share with stakeholders for better decision-making and management.

E. Space applications for energy

31. Alongside the rapid expansion and growth experienced throughout Asia and the Pacific, nearly half a billion people are still lacking access to electricity. More than 80 per cent of the countries in the region have targets to improve energy efficiency and increase the share of renewable energy within

[19] E/ESCAP/73/31, annex II.

[20] See https://sites.tufts.edu/gis/files/2016/01/Usman_Mohammad_DHP207_2016.pdf.

[21] Business Wire, "Russia transportation and logistics market insights report 2017: research and markets", 2 January 2018. Available at www.businesswire.com/news/home/20180102005484/en/Russia-Transportation-Logistics-Market-Insights-Report-2017.

the region.[22] The Committee on Energy, at its first session, acknowledged the new Asia Pacific Energy Portal, which offers access to comprehensive statistical data and visualization, using space applications. Using this geospatial data can contribute to more efficient and knowledge-based decision-making processes, potentially leading to more targeted intervention efforts.

32. In India, the potential of solar and wind power is being harnessed by using remote sensing technology and mapping renewable energy sources. Satellite data were used to assess the actual solar power potential of concentrated solar power and centralized solar photovoltaic systems in each district. GIS and remote sensing can help identify key solar power locations, calculate technical requirements and identify the economic viability of systems.[23] To increase the renewable energy consumption in India, a comprehensive GIS-based energy map and a geospatial energy portal are being developed.[24]

33. In Georgia, the energy sector is considered to be one of the main users of space applications and data resources. Space applications such as digital maps and satellite imagery and data on the ownership of lands and registration can be used in the construction of hydropower plants, and to analyse potential sites for natural oil and gas reserves. Between 2012 and 2017, 23 new thermal power plants (with a capacity of 782.15 megawatts), one hydropower plant and one wind power plant were installed in Georgia. Using geospatial applications and data, the country is working towards a future of sustainable, renewable energy.[25]

34. In Indonesia, through the increased use of space applications, the best practices and programmes are being utilized to increase the share of renewable energy through GIS and data-driven research. Indonesia has a renewable energy target of 23 per cent by 2025, and important strides are being made towards universal access to power across the whole country.[26] Using night-time Earth-observation data, an electricity network has been developed in the eastern part of the country. This is extremely important as most of the population of that area live in remote mountainous or island communities with little access to power.

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[22] E/ESCAP/73/31, annex II.

[23] Richa Mahtta, P.K. Joshi and Alok Kumar Jindal, "Solar power potential mapping in India using remote sensing inputs and environmental parameters", *Renewable Energy*, vol. 71 (November 2014).

[24] India, presentation to the Drafting Committee for the new Asia-Pacific plan of action at its first meeting, Bangkok, 31 May and 1 June 2018. Available at www.unescap.org/sites/default/files/Committee%20Member%20Presentation-India_0.pdf.

[25] Georgia, presentation to the Drafting Committee for the new Asia-Pacific plan of action at its first meeting, Bangkok, 31 May and 1 June 2018. Available at www.unescap.org/sites/default/files/Committee%20Member%20Presentation_Georgia_rev_0.pdf.

[26] Australian Consulate-General in Makassar, Indonesia, "Renewable energy field study: eastern Indonesia", October 2017. Available at http://australiaindonesiacentre.org/app/uploads/2017/10/Renewable-Energy-Field-Study-Overview-wide-distribution.pdf.

F. Space applications for social development to leave no one behind

35. The Ministry of Health of Indonesia is using available satellite communications and systems to enhance its health system. By implementing e-health – the use of information and communications technology to help retrieve and exchange health data and health-care services more efficiently, effectively and safely, covering electronic medical records, surveillance systems, health knowledge management, telemedicine, consumer health informatics, e-learning in health sciences and medical research – the Ministry is able to provide more readily available data, which is especially relevant to an extensive archipelago whose population is dispersed across thousands of islands, making health services and data difficult to maintain. The e-health system can help organize patient data and improve the overall care of patients, as effective clinical workflows are established and maintained. The use of space applications in e-health improves the overall quality of health facilities across the country.

36. GIS data being used in countries such as the Philippines show that access to road infrastructure and proximity to major markets have a significant effect on poverty incidence.[27] Another concrete example is the use of geospatial data and GIS by the city government of Busan in the Republic of Korea to identify the optimal location to build social welfare facilities for disabled persons. By combining data on basic living standards and the status of residents in existing welfare centres, GIS were used to determine the best location while considering the mobility of residents, moving route and accessibility of facilities.[28]

37. India is currently developing the National Spatial Data Infrastructure, which uses extensive GIS databases and resources. A national GIS has been integrated into the Government's Twelfth Five-Year Plan (2012–2017) with a view to creating a new paradigm for governance and development with an emphasis on inclusive growth and development, especially to reduce disparity, expedite development and bring demographic dividends. The new national GIS will help with the mapping of resources, disparities and the needs of beneficiaries and society, and will support sustainable and spatial planning, enable transparent systems for an inclusive society, and support real-time mapping of feedback and redress systems.[29]

III. Gaps and policy challenges

38. Despite advances in space applications and improvements in regional partnerships, gaps and challenges remain in terms of knowledge- and information-sharing, capacity development and technical assistance, as well as the forging of regional connections, norms and standards in developing countries. Countries require not only better technology, tools and infrastructure,

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[27] Brandon Manalo Vista, "Exploring the spatial patterns and determinants of poverty: the case of Albay and Camarines Sur Provinces in Bicol Region, Philippines", MSc dissertation, University of Tsukuba, 2008. Available at http://giswin.geo.tsukuba.ac.jp/sis/thesis/Vista_Brandon.pdf.

[28] Kwang-Hoon Son, "A case study on functional shift and specialization of social welfare centre to social welfare for people with disability utilizing GIS analysis in Haeundae-Gu of Busan Metropolitan City", abstract, *Journal of Community Welfare* (Republic of Korea), vol. 44 (2013). Available at www.dbpia.co.kr/Journal/ArticleDetail/NODE02373981.

[29] Environmental Systems Research Institute, "India: a vision for national GIS", May 2014. Available at www.esri.com/library/ebooks/india-a-vision-for-national-gis.pdf.

but also human capacity to operate and manage them, with skills such as those related to digital technology and creativity. Many developing countries, including small island developing States, do not have a critical mass of people who can utilize, analyse and interpret space application information at the country level.

39. Many of these challenges in accessing and building capacity for using space applications can be addressed through regional cooperation. Good examples of programmes that bring together the expertise of spacefaring countries, and those that use space applications extensively, to support member States with less capacity have already been demonstrated. Such examples include the various ESCAP knowledge products, as well as capacity development provided through the Regional Space Applications Programme for Sustainable Development. However, these programmes need to be scaled up, with a focus on cutting-edge innovations that provide policymakers with advice that is ahead of the curve, if countries are to continue to effectively unleash the potential of the technological and information advances in the space sector.

40. Notwithstanding the ongoing capacity-building programmes, scholarships and individual projects that are being provided in the region, more intense delivery of research, policy analysis and training through regional cooperation is therefore needed for low-capacity countries. In some instances, more extensive institutional development of national education institutes and curricula will be essential to support the scaling-up of individual capacity-building programmes.

41. Beyond this though, there is a greater need to bridge the gap between the space applications community – with its own language, priorities and means of working – and the potential end users who could benefit from Earth-observation information. In addition, many excellent pilot activities are being undertaken in the region. Unless the benefits and potential of these activities are applied across other important sectors, including planning and financing, they will remain academic activities and will not be incorporated into country development plans.

IV. The way forward: the Asia-Pacific plan of action on space applications for sustainable development (2018–2030)

42. As a follow-up to the successful implementation of the Asia-Pacific Plan of Action for Applications of Space Technology and Geographic Information Systems for Disaster Risk Reduction and Sustainable Development, 2012–2017, the secretariat is supporting member States in formulating a new Asia-Pacific plan of action on space applications for sustainable development (2018–2030). The aim is to further scale up the use of space applications and geospatial information to achieve the regional road map for implementing the 2030 Agenda for Sustainable Development and relevant global agendas.

43. At its first meeting, held in late May 2018, the Drafting Committee for the new Asia-Pacific plan of action prioritized the Sustainable Development Goal targets to which space applications could most significantly contribute. It identified 48 Goal targets, and the corresponding targets of the Sendai Framework for Disaster Risk Reduction 2015–2030, as being high- or medium-priority in terms of their role and applicability. It also proposed concrete actions that could be associated with those targets, centred around (a) research and knowledge-sharing, (b) capacity-building and technical

support and (c) regional intergovernmental norm- and standard-setting processes. Discussions also covered the use and appropriateness of indicators for measuring the progress of implementation.

44. The Drafting Committee was of the view that the 48 Goal targets selected should contribute to the priority thematic areas outlined in the regional road map, in the following order: (a) disaster risk reduction and resilience; (b) climate change; (c) management of natural resources; (d) connectivity; (e) energy; and (f) social development.

45. The Drafting Committee was also of the view that the new regional plan of action should encompass and define a concept entitled "Space+", which would seek: (a) to leverage frontier technologies such as artificial intelligence and big data; (b) to engage end users in multiple sectors, youth and the private sector; (c) to more effectively manage information through the creation of a regional or national cloud-based metadata platform; and (d) to strengthen implementation through the creation of a trust fund and through enhanced partnership with global and regional stakeholders.

46. The final plan of action will be presented for adoption along with a declaration at the third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, to be held on 10 October 2018, and the outcomes will be submitted to the Commission for endorsement at its seventy-fifth session.

V. Recommendations

47. Based on a two-year preparatory process and in view of the background and issues identified above, the Committee may wish:

(a) To encourage member States to mobilize the participation of ministers and high-level policymakers and decision makers in the area of space technology and space applications, national space agencies, and science and technology ministries at the third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, to be held in Bangkok on 10 October 2018;

(b) To encourage the Ministerial Conference to adopt a ministerial declaration and an Asia-Pacific plan of action on space applications for sustainable development (2018–2030) and support their endorsement by the Commission at its seventy-fifth session, in 2019;

(c) To agree to commissioning an Asia-Pacific report on geospatial information applications for sustainable development, to be published biennially, which would enhance the availability of research and knowledge products on new regional trends in digitally led innovations in geospatial information applications and services.

United Nations ESCAP/CICTSTI/2018/5

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Committee on Information and Communications Technology, Science, Technology and Innovation

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Item 3 (c) of the provisional agenda*
Policy issues for information and communications technology: regional capacity-building on information and communications technology for development

Report of the Asian and Pacific Training Centre for Information and Communication Technology for Development on its activities during the period 2016-2018

Summary

Established in June 2006 as a regional institute of the Economic and Social Commission for Asia and the Pacific, the Asian and Pacific Training Centre for Information and Communication Technology for Development assists member States in building their human and institutional capacities to use information and communications technology (ICT) for sustainable development. The Centre implements training programmes for policymakers, students and youth, and women entrepreneurs and facilitates the sharing of knowledge and experiences on ICT human capacity development.

The present document contains a report on the activities undertaken by the Centre since the first session of the Committee on Information and Communications Technology, Science, Technology and Innovation, which was held in Bangkok from 5 to 7 October 2016.

The Committee is invited to take note of the report.

I. Introduction

1. Established in June 2006 as a regional institute of the Economic and Social Commission for Asia and the Pacific (ESCAP), the Asian and Pacific Training Centre for Information and Communication Technology for Development has a mandate to assist member States in strengthening their human and institutional capacities to use information and communications technology (ICT) for sustainable development.

2. The Centre implements flagship training programmes for policymakers, students and youth, and women entrepreneurs. It provides platforms for knowledge-sharing on ICT for development, produces knowledge resources to foster the exchange of good practices and lessons learned, and advocates ICT human capacity development in international dialogues and conferences.

* ESCAP/CICTSTI/2018/L.1.

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3. The Centre's programme of work contributes to subprogramme 5, on ICT and disaster risk reduction and management: specifically, under the 2016–2017 strategic framework, it contributes to expected accomplishment (c), on strengthened capacity of member States to apply ICT, space applications and disaster risk reduction strategies and management for inclusive, equitable, sustainable and resilient development; and, under the 2018–2019 strategic framework, to expected accomplishment (c), on strengthened capacity of member States to use ICT, space technology applications and disaster risk reduction and management for resilient and sustainable development.

4. The Centre's Governing Council reviews the administration, financial status and implementation of its programme of work and provides strategic advice on future programmes and activities. The Council is composed of representatives of eight member States and a representative nominated by the host country, the Republic of Korea. At the seventy-first session of the Commission, in 2015, the following countries were elected as members of the Council for the period 2015–2018: Bangladesh; Cambodia; India; Indonesia; Pakistan; Philippines; Sri Lanka; and Thailand.

II. Activities undertaken since the first session of the Committee on Information and Communications Technology, Science, Technology and Innovation

5. Since the first session of the Committee on Information and Communications Technology, Science, Technology and Innovation, which was held in Bangkok from 5 to 7 October 2016, the Centre has continued to enhance its capacity-building programmes, expand its reach in the region and facilitate knowledge-sharing on the role of ICT in achieving inclusive and sustainable development.

6. Recognizing that ICT is a development enabler that cuts across all sectors, the Centre has been strengthening efforts to integrate its work into the regional priorities and subprogrammes of ESCAP. It cooperates with ESCAP divisions and subregional offices and draws on their expertise in programme development and delivery.

A. Training

7. Training is at the heart of the work of the Centre. The Centre adheres to a flagship-programme approach to ensure greater focus on its training activities. It is currently implementing three flagship training programmes: the Women ICT Frontier Initiative, the Academy of ICT Essentials for Government Leaders and the Primer Series on ICT for Development for Youth.

1. Women ICT Frontier Initiative

8. Since the first session of the Committee, the Centre has intensified implementation of the Women ICT Frontier Initiative, a flagship ICT capacity development programme for promoting women entrepreneurship, which was launched by the Centre in June 2016.

9. A core imperative of the 2030 Agenda for Sustainable Development is the global commitment to promote gender equality and the empowerment of women. Gender is a cross-cutting issue that is mainstreamed into all Sustainable Development Goals and targets. Member States are called to achieve gender equality and empower all women and girls (Goal 5) and to

enhance the use of enabling technology, in particular ICT, to promote the empowerment of women (Goal target 5.b).

10. Through the Women ICT Frontier Initiative, the Centre endeavours to empower women socially and economically through ICT-enabled entrepreneurship. It aims to strengthen the capacity of women entrepreneurs in Asia and the Pacific to use ICT in support of their businesses and the capacity of policymakers to create an enabling environment for ICT-empowered women entrepreneurs.

11. A series of national and subregional launches for the Women ICT Frontier Initiative has been held by the Centre, in close partnership with ICT and gender ministries, civil service institutions, training organizations, civil society and women's associations, and other stakeholders. Over the reporting period, the following national and subregional launches were held:

(a) In Sri Lanka, the national launch was held in Colombo on 26 September 2016, in partnership with the Information and Communication Technology Agency of Sri Lanka and the Ministry of Women and Child Affairs. For its initial roll-out, the programme is targeting female heads of household in post-conflict Sri Lanka. A training-of-trainers course was held in Colombo on 27 and 28 September, followed by community workshops in Badulla and Kilinochchi districts, which were severely affected by the country's civil war.

(b) In Cambodia, the launch was held in Phnom Penh on 21 December 2016, in partnership with the secretariat of the One Village One Product National Committee and the Ministry of Women's Affairs. It was preceded by a three-day training-of-trainers course, from 19 to 21 December 2016, that helped to expand the pool of local resource persons who can deliver the training in the country. The programme is being brought to the country's provinces in partnership with the One Village One Product National Committee, the Ministry of Women's Affairs, and women entrepreneurs associations.

(c) In Kyrgyzstan and Central Asia, the Centre launched the programme in Bishkek on 27 April 2017, in cooperation with the Academy of Public Administration under the President of the Kyrgyz Republic and the Central Asian Research and Education Network. The event was followed by a subregional training-of-trainers course for women entrepreneurs and policymakers from Central Asian countries.

(d) In Bangladesh, in cooperation with the ICT Division of the Government of Bangladesh and the Bangladesh Computer Council, the programme was launched in Dhaka on 5 July 2017. The Government adopted the programme in line with its national ICT strategy, Digital Bangladesh, whose aim is to transform the country into a modern and inclusive knowledge-based society by 2021, not only through the development of countrywide ICT infrastructure but also through ICT human resource development. The ICT Division aims to provide ICT and entrepreneurship training to 30,000 women entrepreneurs in the country.

(e) In the Association of Southeast Asian Nations (ASEAN) and the Philippines, the ASEAN launch was held on 28 August 2017, in conjunction with the ASEAN Women's Business Conference, which took place in Manila from 28 August to 1 September 2017. The Action Agenda on Mainstreaming Women's Economic Empowerment was adopted by the conference, calling for all stakeholders to support the implementation of the Women ICT Frontier Initiative in ASEAN member States. In collaboration

with the ASEAN Women Entrepreneurs Network, the Philippine Commission on Women, and the Department of Information and Communications Technology and Department of Trade and Industry of the Philippines, a training-of-trainers course for policymakers and women entrepreneurs was organized on 29 and 30 August 2017. A Philippine stakeholders group meeting was held on 30 August to discuss mainstreaming strategies for national implementation of the programme.

(f) In Armenia, the Centre launched the programme at Yerevan State University in Yerevan on 29 September 2017 in cooperation with the Civil Service Council of the Republic of Armenia, the Public Administration Academy, Yerevan State University and the Armenian Young Women's Association. Prior to the launch, a training-of-trainers course was held for policymakers and women entrepreneurs, from 26 to 28 September 2017.

(g) In India, the Centre launched the programme in Tirupati, Andhra Pradesh, on 19 February 2018, in partnership with Sri Padmavati Mahila Visvavidyalayam (Women's University). A training-of-trainers course was held from 20 to 22 February 2018, followed by a stakeholders group meeting that focused on how to link the programme to the State government's initiatives on promoting innovation and entrepreneurship culture.

2. Academy of ICT Essentials for Government Leaders

12. Launched in 2008 as the Centre's first flagship training programme, the Academy of ICT Essentials for Government Leaders is aimed at strengthening the capacities of policymakers and civil servants to leverage ICT in national development strategies and programmes. The programme has been utilized in 35 countries by subregional and national partners from ICT ministries, civil service organizations, civil society and academia.

13. The Academy consists of 11 training modules, covering a range of topics on ICT for development: Linkage between ICT Applications and Meaningful Development (module 1); ICT for Development Policy, Process and Governance (module 2); eGovernment Applications (module 3); ICT Trends for Government Leaders (module 4); Internet Governance (module 5); Information Security and Privacy (module 6); ICT Project Management in Theory and Practice (module 7); Options for Funding ICT for Development (module 8); ICT for Disaster Risk Management (module 9); ICT, Climate Change and Green Growth (module 10); and Social Media for Development (module 11).

14. Over the reporting period, the Centre produced a new Academy module entitled "An Overview of ICTs and Sustainable Development", which provides an introduction to the intersections between ICT and the Sustainable Development Goals. Its aim is to inform policymakers on the various dimensions and sectors in which ICT can provide support for national Governments in their sustainable development plans and programmes.

15. Given the emergence of data as important assets for Governments to make informed decisions in their socioeconomic development, the Centre has been developing a new Academy module on data-driven governance. The aim of the module is to enhance civil servants' understanding of the role of data in evidence-based policymaking and in implementing and monitoring national progress on the Sustainable Development Goals. An expert group meeting was held in Manila on 6 December 2017 to solicit feedback from experts and practitioners on a draft module, which will be finalized in late 2018.

16. The Centre conducts national-level capacity-building workshops for civil servants in cooperation with national ICT ministries and civil service training institutes. The following activities were undertaken over the reporting period:

(a) In Bhutan, the Centre conducted a capacity-building programme on social media for development in Thimphu from 28 October to 4 November 2016. Co-organized with the Ministry of Information and Communications, the five-day programme consisted of a high-level briefing session for members of the National Council of Bhutan, a one-day training session for senior-level government officials, and a two-day workshop for information and media officers on social media for development and governance and social media policy implementation. A second Academy workshop, on ICT, climate change and green growth, was held in Thimphu on 26 and 27 October 2017. The Centre collaborated with the Royal Institute of Management to organize the training, which was attended by civil servants from the National Environment Commission as well as ICT and telecommunications organizations.

(b) In Myanmar, the Union Civil Service Board has integrated the Academy into its training programme for senior government officials. It included the Academy as a core component of its executive officials management course, which is conducted annually with other international partners including the United Nations Development Programme, the World Bank and the European Union. Over the reporting period, four Academy workshops for executive officials were held in Myanmar:

(i) Academy workshop on eGovernment applications, Internet governance, and network and information security and privacy (Lower Myanmar, 20 to 24 February 2017);

(ii) Academy workshop on ICT and sustainable development, ICT and project management, and social media for development (Upper Myanmar, 31 July to 4 August 2017);

(iii) Academy workshop on eGovernment applications and broadband connectivity (Lower Myanmar, 6 to 10 November 2017);

(iv) Academy workshop on eGovernment Applications, and information security and privacy (Lower Myanmar, 19 to 23 March 2018).

17. Demonstrating the Academy's integration into national civil service human resource development programmes, the Centre's national partners continue to use Academy resources in civil service training. These partners include ICT ministries and civil service organizations in countries such as Armenia, Bhutan, China, India, Indonesia, Kazakhstan, the Lao People's Democratic Republic, Mongolia, Myanmar, Pakistan, the Philippines, Tajikistan, Turkmenistan and Uzbekistan.

3. Primer Series on ICT for Development for Youth

18. Launched in 2012, the Primer Series aims to sensitize society's future leaders – students and youth from colleges and universities – to the enabling role of ICT in promoting sustainable development. It consists of learning resources that can be used by institutions of higher learning and integrated into academic curricula.

19. The Centre continued to promote the Primer Series in the region through high-level briefings for officials of the relevant bodies governing

tertiary education as well as administrators and professors of colleges and universities, to inform them about the content of the Primer Series and how these resources can be utilized in classroom teaching. These high-level briefings included one in Phnom Penh on 23 December 2016 and one in Bishkek on 28 April 2017.

20. Partner institutions from colleges and universities in the region have been using the Primer Series resources in their curricula, including the following: Build Bright University (Cambodia); Institute of Information Technology Bangalore (India); International Information Technology University (Kazakhstan); Kathmandu University (Nepal); Kyrgyz State Technical University (Kyrgyzstan); Royal University of Phnom Penh (Cambodia); Satbayev University (Kazakhstan); Tashkent University of Information Technologies (Uzbekistan); Universitas Gadjah Mada (Indonesia); University of Hyderabad (India); University of Moratuwa (Sri Lanka); and University of Technology, Yadanabon Cyber City (Myanmar).

B. E-learning and knowledge-sharing platforms

1. Virtual Academy

21. The Virtual Academy – the Centre's e-learning platform – is central to Centre's strategy to diversify its training delivery channels, extend outreach and facilitate self-learning. The total number of course enrolments since the launch of the platform in 2009 has reached more than 12,330. Registered users are from 152 countries, with 34 per cent of the users from government agencies, 33 per cent from academia, 14 per cent from non-governmental organizations, 12 percent from the private sector and 7 per cent from development agencies.

22. **New online courses on ICT and women entrepreneurship**. Over the reporting period, the Centre developed online versions of the training modules for the Women ICT Frontier Initiative. These include two core modules, entitled "Women's Empowerment, Sustainable Development Goals and ICT" and "Enabling Role of ICT for Women Entrepreneurs"; two specialized modules for women entrepreneurs, entitled "Planning a Business Using ICT" and "Managing a Business Using ICT"; and one specialized module for policymakers, entitled "An Enabling Environment for Women Entrepreneurs".

23. **Migration to the consolidated United Nations online platform**. The Centre migrated the Virtual Academy to the integrated online United Nations platform managed by the Office of Information and Communications Technology of the Secretariat. This migration is expected to result in enhanced technical capacity and greater visibility, synergy with other United Nations online platforms, and improved security. New features were also introduced to enhance accessibility using mobile devices.

2. Women ICT Frontier Initiative InfoBank

24. The Women ICT Frontier Initiative InfoBank is the Centre's online knowledge-sharing platform for ICT-enabled women entrepreneurship. It houses the Centre's knowledge products, including training modules and localized contents as well as case studies on women entrepreneurs using ICT.

25. Over the reporting period, the Centre enhanced the platform with newly added sections and improved the configuration of knowledge content. New sections include content for country-specific activities, localized resources (including audiobooks), news articles, and resources related to financial

literacy programmes. Links to relevant external resources have been added to the knowledge portal.

3. eCollaborative Hub

26. The eCollaborative Hub is a repository of knowledge resources on ICT for development. The Centre is continuing to enrich the platform, which now features over 1,270 resources, including publications, reports, journal articles, working papers, training manuals and case studies. The portal had been viewed more than 394,700 times as of May 2018.

C. Advocacy and outreach

1. The Centre's website

27. The Centre's website (www.unapcict.org) is its principal channel for communicating and disseminating its capacity development programmes, resources and activities to the public. The website had generated more than 1,227,100 page views as of May 2018.

2. Advocacy on information and communications technology capacity development at international, regional and national conferences

28. The Centre continued to advocate the enabling role of ICT for sustainable development, the importance of ICT human capacity development, and its flagship programmes through presentations, keynote speeches and panel sessions at notable events, including:

(a) The Fifteenth Meeting of the ASEAN Committee on Women, Singapore, 6 October 2016;

(b) The Government 3.0 Global Forum 2016, Busan, Republic of Korea, 9 to 11 November 2016;

(c) The Korea Institute of Ocean Science and Technology International Seminar 2016, Seoul, 1 December 2016;

(d) An international symposium entitled "Promoting Women's Human Rights and Participation in Conflict-affected Settings", Seoul, 9 December 2016;

(e) The Second Central Asian Research and Education Network Regional Networking Conference, Bishkek, 26 April 2017;

(f) The Pakistan eWomen Multi-stakeholder Group Meeting, Islamabad, 2 May 2017;

(g) A workshop entitled "Rural Community Development – Women and Youth Empowerment", Seongnam, Republic of Korea, 30 May 2017;

(h) The 2017 Asia-Pacific Youth Exchange, Incheon, Republic of Korea, 13 August 2017;

(i) The "International Organizations and MICE (Meeting, Incentives, Conferences and Events) Careers Fair", Songdo, Incheon, Republic of Korea, 17 November 2017.

3. Media

29. The Centre's programmes and activities have been covered in electronic and print media from both international outlets and those of the

Republic of Korea. As of May 2018, the Centre had been featured in 754 news items: 382 features were covered by international media (news articles and radio and television coverage) and by other United Nations entities and international organizations, while 372 news items were covered by media of the Republic of Korea.

D. Strategic partnerships

30. Networking and forging partnerships at the regional, subregional and national levels are central to the Centre's capacity development strategy in Asia and the Pacific. The Centre maintains partnerships with central ministries and agencies, academic and research institutions, United Nations and international organizations, regional organizations and networks, civil society organizations, the private sector, the media, and government ministries and agencies of the host country.

E. Governing Council

31. Annual sessions of the Governing Council are held to review the administrative and financial status of the Centre, the progress of implementation of its programme of work, and the development of its annual workplan. The eleventh session of the Council was held in Bangkok on 5 and 6 October 2016, in conjunction with the first session of the Committee. The twelfth session of the Council was held in Manila on 7 December 2017.

III. Issues for consideration

32. The Committee may wish to identify priority areas and activities that could be undertaken by the Centre through its flagship programmes to support enhanced understanding and use of ICT for implementation of the 2030 Agenda

33. The Committee may wish to highlight good examples of the use of ICT for development from across Asia and the Pacific to inform the future work of the Centre.

34. The Committee may wish to identify and provide further guidance on emerging needs with respect to ICT capacity development in the region, as well as on other areas that could be undertaken by the Centre, in alignment with the 2030 Agenda.

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Policy issues for science, technology and innovation: mainstreaming inclusive technology and innovation policies that leave no one behind

Mainstreaming inclusive technology and innovation policies that leave no one behind

Note by the secretariat

Summary

Technology and innovation have helped to achieve an unprecedented level of economic growth in Asia and the Pacific. They have also expanded access to basic opportunities and services and offered means to address environmental concerns. However, not everyone has been able to benefit from such opportunities.

Harnessing technology and innovation to achieve the Sustainable Development Goals and leaving no one behind requires promoting not only more technologies and innovations but also more inclusive ones.

The Asia-Pacific region hosts some of the more transformative efforts to use technology and innovation for inclusive development. Just a few examples include the grass-roots movement driving community-led innovation to address local social and economic needs in India, small entrepreneurs earning a better living by trading online in Indonesia, women furthering scientific careers in Malaysia, research addressing social problems in the Republic of Korea, frontier technologies enabling better care for older persons in Japan, and technology transfer enabling affordable access to clean energy in rural areas of Tajikistan.

Most inclusive innovations are developed by firms, entrepreneurs, grass-roots innovators and development organizations. However, public policies are still required. Left on their own, valuable inclusive technologies and innovations may not flourish, reach scale or diffuse throughout society.

The present document contains information on approaches adopted by Governments in Asia and the Pacific to support inclusive technologies and innovation. It also contains highlights of key issues for promoting inclusive innovations that require further consideration: building political support for an inclusive innovation agenda; managing trade-offs between economic, social and environmental objectives; setting priorities and resourcing them adequately; developing greater understanding of policies that support inclusive innovation; and monitoring and evaluating the impact of these policies.

* Reissued for technical reasons on 20 July 2018.

** ESCAP/CICTSTI/2018/L.1.

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The Committee may wish to share national experiences, including good practices and lessons learned, in promoting inclusive technology and innovation policies that leave no one behind. The Committee is invited to reflect on policy priorities to ensure that technology and innovation contribute to inclusive societies and markets. The Committee is also invited to indicate what support may be required, such as training, research or advisory services, from the secretariat to promote inclusive technology and innovation.

I. Introduction

1. Technology and innovation provide immense opportunities for society, the economy and the environment. They have the potential to increase the efficiency, effectiveness and impact of efforts to meet the Sustainable Development Goals.

2. In the 2030 Agenda for Sustainable Development,[1] Governments committed to using technology as a critical means of implementation. Member States have also pledged to leave no one behind in their efforts to achieve sustainable development.

3. Technology and innovation, together with the opportunities provided by trade and investment for capital accumulation and productive transformation, have helped to achieve an unprecedented level of economic growth in Asia and the Pacific, enabling several countries to catch up with developed nations. They have also expanded access to basic opportunities and services – such as education, health and energy – and offered means to address environmental concerns.

4. However, not everyone has benefited from such opportunities. Income and wealth inequalities are on the rise in the Asia-Pacific region and globally. The region's combined income inequality, measured by the Gini coefficient, has increased by more than 5 percentage points in the last 20 years.[2] Least developed countries and countries with special needs have not been able to build technological capabilities and are lagging further behind. Rural communities, women, persons with disabilities, and other vulnerable and low-income groups are often unable to make full use of technologies and innovation.

5. Harnessing technology and innovation to achieve the Sustainable Development Goals and leave no one behind requires promoting more technologies and innovation, particularly the more inclusive ones, that address the needs of lower-income and vulnerable groups.

6. The Asia-Pacific region hosts some of the most transformative efforts to use technology and innovation for inclusive development. Just a few examples include the grass-roots movement driving community-led innovation to address local social and economic needs in India, small entrepreneurs earning a better living by trading online in Indonesia, inclusive businesses providing affordable access to health care in India, women furthering scientific and technological careers in Malaysia, research programmes addressing social problems in the Republic of Korea, frontier technologies addressing the needs of an ageing population in Japan, digital identification platforms enabling

[1] General Assembly resolution 70/1.

[2] *Inequality in Asia and the Pacific in the Era of the 2030 Agenda for Sustainable Development* (United Nations publication, Sales No. E.18.II.F.13).

financial inclusion in India and technology transfer enabling affordable access to clean energy in rural areas of Tajikistan.

7. This present document contains a review of key concepts related to inclusive technology and innovation policies and a sample of public initiatives that have supported inclusive technology and innovation in the Asia-Pacific region. It is not a comprehensive review but a starting point for discussions on the opportunities that Governments need to encourage, enable and emulate for more inclusive innovation.

II. Key concepts and approaches

A. Inclusive innovation

8. Inclusive innovation comprises, in its broadest sense, initiatives that serve the welfare of lower-income and excluded groups. The concept of inclusive innovation encompasses diverse, contested and often competing perspectives.[3] Two broad perspectives can be used to outline inclusive innovation: (a) innovations for the poor or pro-inclusive innovation, a simpler and market-based perspective that defines inclusive innovation as innovation that promotes the creation of products and services that are specifically designed to meet the needs of low-income or excluded groups; and (b) innovation by the poor, or grass-roots innovation, a more complete notion of development and inclusion that defines inclusive innovation as innovation that is carried out by low-income or excluded groups.[4] In practice, inclusive innovation develops within a continuum of these contrasting perspectives. The framing of the inclusion challenge has implications for the choice of policy priorities and of policy instruments to be used.

9. Inclusive innovation includes both technological innovations – for example, the redesign of a portable electrocardiograph costing a fraction of a standard one – and non-technological innovations – such as the reorganization of service delivery to make heart surgery more affordable to low-income groups.

B. Leaving no one behind

10. Leaving no one behind[5] means ending absolute poverty but also reducing inequalities among individuals and groups and ensuring that those who have been left behind (in absolute and relative terms) can catch up with those making progress. It means prioritizing and fast-tracking action for the furthest behind, including youth, persons with disabilities, older persons and indigenous peoples, as well as women and the poor. It recognizes that explicit and proactive attempts are needed to put those left behind first. It requires, for example, identifying those left behind, understanding their needs, focusing policies on places in which left behind groups live, promoting inclusive economic growth and reducing inequality in all its forms.

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[3] Mario Pansera and Richard Owen, "Framing inclusive innovation within the discourse of development: insights from case studies in India", *Research Policy*, vol. 47, No. 1 (February 2018), pp. 23–34.

[4] Organization for Economic Cooperation and Development (OECD), "Innovation policies for inclusive development: scaling up inclusive innovations" (Paris, 2015).

[5] Elizabeth Stuart and Emma Samman, "Defining 'leave no one behind'", Briefing note (London, Overseas Development Institute, 2017).

C. Social, industrial and territorial inclusiveness

11. Inclusiveness has a social dimension (ensuring women, low-income groups, persons with disabilities, older persons and other vulnerable groups are included), an economic dimension (ensuring that micro-, small and medium-sized enterprises can fully participate in economic activities) and a geographic dimension (reducing disparities within and between countries).

III. Arguments for inclusive technologies and innovations

12. Promoting inclusive technologies and innovations makes sense for multiple reasons. First, inclusive innovation can support more resilient economies by enabling broad-based growth. Second, it promotes social welfare and social justice by increasing opportunities to make goods and services available to low-income and other marginalized groups and by enabling marginalized groups to take part in innovation activities.

13. Inclusive innovations and technologies provide a broader productive base and additional opportunities for economic growth. For example, the Spark Plan of China, implemented between 1986 and 2015, has promoted economic development in rural areas through the transfer and diffusion of technologies and knowledge. With an average annual budget of $70 million, the programme has stimulated the development of local agricultural and other industries in rural areas. The Spark industrial belt has encompassed 114,000 companies and a total labour force of 12.3 million.[6]

14. Inclusive technologies and innovations are critical to enhance social welfare and social justice and to address inequalities in access to goods and services. Frugal innovations[7] in health care are expanding health services to a wider population. Narayana Health is a chain of hospitals in India providing high-quality, affordable care. Its business model combines innovative technology with a highly efficient delivery system to optimize productivity and minimize costs. As a result, the average cost of open-heart surgery is less than $2,000, whereas the same procedure in the United States of America would cost $100,000. Inclusive financial innovations, such as the Aadhaar digital identity programme in India, have greatly expanded financial inclusion. However, technology and innovation can exacerbate inequality and the exclusion of marginalized segments of the population.[8] More inclusive approaches to the development of technologies help to redress this by ensuring that the benefits of technologies are more evenly spread across societies.

IV. Why are public policies needed to promote inclusive technologies and innovations?

15. Most inclusive innovations are developed by firms, entrepreneurs, grass-roots innovators and development organizations. However, public policies are still required to address market, systemic and transformational failures that prevent the emergence and diffusion of inclusive technologies and innovations. Left on their own, valuable inclusive technologies and innovations may not flourish, reach scale or diffuse throughout society.

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[6] OECD, "Innovation policies for inclusiveness – policy cases: Spark plan: People's Republic of China" (2017).

[7] The term frugal innovations refers to innovations that reduce the complexity and cost of goods and services and their production or delivery.

[8] *Inequality in Asia and the Pacific*.

16. Inclusive innovation policies can help to address market failures by providing resources and incentives to develop and adopt inclusive technologies, by reducing the risks associated with their development and adoption. In Tajikistan, public policies are providing an enabling regulatory environment for the diffusion of small-scale renewable energy technologies.

17. Public policies can help to bring about inclusive innovations by enabling learning and joint action between different stakeholders and by intermediating between formal and informal systems of innovation. For example, the National Innovation Foundation of India has boosted grass-roots innovations by facilitating the documentation of grass-roots innovations and traditional knowledge, linking informal knowledge systems with formal scientific systems and supporting knowledge networks.

18. Public policies are also crucial in harnessing the direction of innovation towards addressing societal challenges (including poverty, inequality and climate change) and enabling transformational changes. For instance, Japan is explicitly harnessing frontier technologies to address major national challenges such as an ageing population.

19. Inclusive innovation policies are a valuable instrument to support inclusive development. They complement other policy instruments – such as taxation and education policies or rural infrastructure development programmes – to support social. economic and regional inclusion. As taxation policies and public investments are limited in providing social welfare and public goods and services, inclusive technology and innovation policies offer additional and complementary opportunities to sustain inclusive development.

V. Inclusive technology and innovation policies in Asia and the Pacific

20. Inclusive technology and innovation have been supported through a myriad of approaches in Asia and the Pacific and can be grouped in to four areas: (a) strategic approaches that provide direction to the development of technology and innovation; (b) the promotion of inclusive technologies and innovations (for example, promoting appropriate technologies); (c) inclusive growth approaches that promote industrial inclusion; and (d) strategies targeted at removing the barriers that particular groups, such as women and persons with disabilities, face as producers and consumers of technology and innovation. The following subsections contain more information on these approaches.

A. Strategic approaches

21. The first type of approach is a strategic approach. This is when a government promotes an inclusive national science, technology and innovation policy, supports a mission-oriented strategy to address a complex societal challenge (such as financial inclusion) or promotes the inclusive appraisal of technological alternatives (to consider the economic, social and environmental implications of emerging technologies on different groups). Governments can support strategic approaches that provide direction to the development of technology and innovation, allocate resources and make decisions on how outcomes are evaluated.

1. Inclusive national science, technology and innovation policies

22. Policymakers can mainstream the inclusive perspective in national science, technology and innovation policies and promote inclusive technologies and innovation in a holistic manner. Mainstreaming inclusiveness means establishing inclusive outcomes as well as processes in science, technology and innovation policy formulation.

23. Countries have adopted inclusive outcomes in their national science, technology and innovation policies to differing degrees. Often they have focused on inclusive growth outcomes (promoting, for example, the innovation capacities of smaller firms), but they have also included specific objectives for geographic inclusiveness (fostering innovation in rural areas), gender inclusion or investing in research to address domestic challenges.

24. In its Fifth Science and Technology Basic Plan (2016–2020), the Government of Japan seeks to promote inclusive innovation in several areas, including increasing dialogue between society and science, technology and innovation actors; promoting a smart society; promoting diversity and career mobility in science, technology and innovation and in particular improving women's career prospects in these areas; and promoting innovation systems that contribute to regional revitalization.

25. The Plan represents a major shift in the Government's policy, towards addressing both economic and social challenges, and seeks to contribute to sustainable and inclusive development in Japan and abroad. An ageing society, a shrinking population and the loss of public confidence in science are driving this policy shift.

26. For example, the Plan includes the concept of a "super-smart society" (or "society 5.0") where cyberspace and physical space will be highly integrated through new technologies such as artificial intelligence, robotics, the Internet of things, big data and network technologies. In this vision, technology and innovation will improve the quality of life for all citizens regardless of their age, gender, language or region. For example, artificial intelligence and robots would provide enhanced nursing care to an ageing population, and public transportation in rural areas would improve thanks to the use of autonomous taxis and buses.

2. Mission-oriented approaches

27. Mission-oriented policies are a set of complementary policies and measures aiming to address complex societal challenges, such as the achievement of financial inclusion or switching to a renewable energy system. Mission-oriented policies guide changes in the direction of technological systems, focus on the diffusion of technologies and, to achieve their objectives, seek the development of both radical and incremental innovations.[9]

28. Governments can support system-wide transformations through public investments, policies and procurement. The role of government in this regard is not only as a market fixer but a market maker. These mission-oriented approaches require leadership from the top, long-term investments, and

[9] Mariana Mazzucato, "Mission-oriented innovation policy: challenges and opportunities", IIPP Working Paper, No. 2017-01 (London, Institute for Innovation and Public Purpose, University College, London, 2017).

comprehensive and coherent supply-and-demand-side policies that support the development and adoption of technologies.

29. A number of Governments in the Asia-Pacific region have successfully introduced mission-oriented policies to promote technologies that bring services to the poor on a large scale.

30. For example, in India, the stack technology platform based on the Aadhaar digital identification system has enabled the financial inclusion of 1.2 billion people. The Aadhaar project is a government-led, technology-based financial inclusion system. It uses a unique identification number (based on biometric and demographic data) linked to a mobile phone number, a low-cost bank account and an open mobile platform. The combination of those elements enabled public and private banks to establish an open and interoperable low-cost payment system that is accessible to everyone with a bank account and a mobile phone. More than 338.6 million beneficiaries have now received direct benefit transfers, saving the Government $7.51 billion over three years.[10]

3. Inclusive appraisal of technological alternatives

31. The development and application of new and emerging technologies poses a number of ethical dilemmas that require understanding of their cost-benefit and economic, social and environmental implications for different groups, decisions on if or how to proceed with their development and considerations of what alternative solutions are possible. Stakeholders often have divergent values and interests regarding the development of new technologies. For instance, synthetic biology[11] – the convergence of life sciences technologies (for example DNA recombination) with other fields such as engineering, computational technology and nanotechnology – offers new opportunities to address major development challenges. Synthetic biology enables, for example, the production of artemisinin, an active ingredient required to treat a lethal type of malaria. Before, artemisinin could only be sourced from the sweet wormwood plant, and its natural cultivation cycle caused lags in supply and price volatility. Synthetic biology provides a more reliable source of artemisinin, but it may also have an impact on the livelihoods of farmers cultivating the crop in developing countries and on biodiversity.

32. Inclusive technology appraisals enable various stakeholders, including potential users, to assess the social, economic and environmental impact of new and emerging technologies and of alternative options and to decide which options, not necessarily technological, best serve their needs.

33. One of the objectives of the Fifth Science and Technology Basic Plan (2016–2020) of Japan is to deepen the relationship between society and science and technology by addressing citizens' loss of confidence in science following the nuclear power incident caused by the great east Japan earthquake and cases of research fraud.

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[10] India, "New innovation approaches to support the implementation of Sustainable Development Goals", statement to the Commission on Science and Technology for Development of the United Nations, twentieth session, Geneva, 10 May 2017.

[11] Friedrich Soltau, "The promise of synthetic biology for sustainable development", brief for the *Global Sustainable Development Report* (GSDR) *2015 Edition*. Available at https://sustainabledevelopment.un.org/content/documents/5468Syn_biology_draft_brief_rev6.pdf.

34. The Plan states that society should be making decisions on ethically or legally contentious issues, such as genetic testing, regenerative medicine and artificial intelligence. It further states that the Government needs to provide a suitable forum for formal or informal communication with the various stakeholders and undertake research on the ethical, legal and social issues with the participation of different social and natural sciences disciplines. Accordingly, the Government must forecast the social benefits and costs of the new technology, as well as its unintended uses, and provide a framework for implementation that balances advantages and disadvantages. The Plan also promotes the formulation of ethical guidelines to guide leading-edge research.

35. Also envisaged in the Plan is the promotion of research on scientific methods for appropriately predicting, evaluating and making decisions based on scientific grounds, for producing technology assessments that comprehensively analyse the impacts of science and technology, and for formulating and implementing regulations, as well as researching ways to manage transitions between social systems.

36. Technology appraisals are an expensive endeavour. To address this limitation and ensure that technology assessments look at the social, economic and environmental impact of emerging technologies and of alternative options, the Action Group on Erosion, Technology and Concentration (ETC Group), a civil society organization, proposes the establishment of regional technology assessment platforms in Asia and the Pacific to enhance technology assessment capacity in developing countries. These platforms would ensure the full and informed participation of marginalized groups in discussion on relevant technology issues.

B. Promoting inclusive technologies and innovation

37. The second type of approach is the promotion of inclusive technologies and innovation, including through research programmes on social problems, appropriate technologies, grass-roots innovations and the transfer of technology to support inclusion.

1. Establishing public research programmes focused on addressing social problems

38. Governments can fund research programmes on social problems that specifically seek solutions to development problems. The Republic of Korea,[12] for example, has dedicated specific resources for multi-departmental research projects addressing priority social problems. Research projects to solve social problems are driven by demand instead of supply and require shifting processes. They require, for instance, joint planning and implementation across different research departments as well as more intense participation by civil society and citizens. In this context, one of the main roles of the government is to establish platforms that enable various stakeholders to effectively participate in the planning and implementation of the activities. Research programmes on social problems, such as on mission-oriented strategies, focus on addressing a social challenge but have a more limited scope as their emphasis is primarily on research.

[12] *Innovative Financing for Development in Asia and the Pacific: Government Policies on Impact Investment and Public Finance for Innovation* (United Nations publication, Sales No. E.17.II.F.23).

2. Sustaining the development and adoption of appropriate technologies

39. It is commonly argued that appropriate or intermediary technologies, namely small-scale, labour-intensive technologies that are simple and affordable, are more relevant for economically poor countries or communities and for inclusive growth paths. For example, in the early nineteenth century, Robert Owen, a manufacturer, sought to develop small mills instead of large-scale mills, in order to empower the workforce and support small communities.[13] E.F. Schumacher, in his seminal book *Small is Beautiful: A Study of Economics as if People Mattered*,[14] argued for intermediary technologies, that is, for simpler technologies that are easier to understand, maintain and repair, that fit more easily into unsophisticated environments and are less vulnerable to unforeseen situations. The notion of appropriate technologies has evolved from being concerned only with the development of appropriate technologies to also being concerned with its deployment. Nowadays, this philosophy underlies efforts to develop and diffuse technologies such as off-the-grid solar panels and mechanical water pumps.

40. The Government of Indonesia has a policy that aims to empower rural communities and small firms through appropriate technologies. The policy is led by the Ministry of Villages, Disadvantaged Regions Development and Transmigration and implemented in collaboration with several ministries, national agencies and local governments. It aims to support economic growth and regional development using appropriate technologies developed by universities and public research institutions.[15]

41. The policy has been supported for nearly two decades; a presidential instruction was adopted in 2001 and two subsequent regulations were adopted (in 2010 and 2017).[16] The main elements include identifying needs for appropriate technology, especially among rural communities and micro-, small and medium-sized enterprises in specific locations; establishing technology service centres at the district level; encouraging universities, public research institutions and technology centres to develop appropriate technologies that respond to community needs; financing the development and diffusion of those technologies; providing technical assistance; and encouraging grass-roots innovations through creativity and innovation contests at the community level.

42. The promotion of appropriate technologies requires policy support that is context appropriate. The Government of Indonesia uses diverse approaches to respond to diverse settings, but this diversification has reduced opportunities for synergies. Weak technology adoption capacities in rural communities are a limiting factor in the diffusion of appropriate technologies.

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[13] Joanna Chataway, Rebecca Hanlin and Raphael Kaplinsky, "Inclusive innovation: an architecture for policy development", Innovation Knowledge Development Working Paper, No. 65 (Milton Keynes, United Kingdom, Open University, 2013).

[14] (London, Blond & Briggs, 1973).

[15] Based on inputs provided by Indonesia's focal point for the Subcommittee on Science and Technology Infrastructure and Resources Development of the Association of Southeast Asian Nations.

[16] Indonesia, Presidential Instruction No. 5 on empowering rural communities through the implementation and development of appropriate technology (2001); Ministry of Home Affairs Regulation No. 20 on community empowerment through management of appropriate technology (2010); and Ministry of Villages, Disadvantaged Regions Development and Transmigration Regulation No. 23 on the development and implementation of appropriate technology in rural natural resource management (2017).

43. The Government of Indonesia has sought to enhance the economic capacity of rural areas by promoting appropriate technologies that are relevant to community needs. Several lessons can be drawn from these experiences: communities need to be involved in the planning, implementation and evaluation of the technologies; technical and non-technical assistance is required; and the coordination of policies across different sectors is indispensable to support appropriate technologies in rural areas.

3. Supporting grass-roots innovation

44. The grass-roots innovation movement, similar to the appropriate technologies movement, supports relevant technologies for communities, however, it focuses on supporting the community to develop their own technologies and knowledge and in recognizing their knowledge. It also values other forms of innovation (for example, educational) beyond technological ones. By placing communities at the centre and sourcing traditional, indigenous knowledge, it allows for innovations to be suited to the local context. Grass-roots innovations are "networks of activists and organizations generating novel bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved".[17] Hence, grass-roots innovations are generated by local communities, rather than by the government or the private sector. Grass-roots innovations are often based on the knowledge and experience embedded in local communities, outside the formal institutions of science, education and research[18] and are commonly developed through experimentation, learning by doing and improvisation by trials.[19] The driving force behind grass-roots innovations is often to meet a social need.[20]

45. Some of the key challenges in supporting grass-roots innovations include accessing appropriate financing and funding; identifying genuine grass-roots innovations; connecting to formal institutions and the wider community; and accessing the supply chain and opportunities for business development.[21] Policies which seek to create a supportive system for grass-roots innovations may consider measures and institutional frameworks that address these challenges.

46. India is a notable example of a country in which grass-roots innovations are part of the national innovation system.[22] The Honey Bee Network, established in 1989, is a key organization within the grass-roots innovation movement in India. The Honey Bee Network, like its namesake, seeks to cross-pollinate ideas and promote the sharing of knowledge between communities.

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[17] Gill Seyfang and Adrian Smith, "Grassroots innovations for sustainable development: towards a new research and policy agenda", *Environmental Politics*, vol. 16, No. 4 (July 2007), pp. 584–603.

[18] Ibid.

[19] Ashok Jain and Jan Verloop, "Repositioning grassroots innovation in India's S&T policy: from divider to provider", *Current Science*, vol. 103, No. 3 (August 2012), pp. 282–285.

[20] Mokter Hossain, "Grassroots innovation: a systematic review of two decades of research", *Journal of Cleaner Production*, vol. 137 (November 2016), pp. 973–981.

[21] Adrian Smith, Mariano Fressoli and Hernán Thomas, "Grassroots innovation movements: challenges and contributions", *Journal of Cleaner Production*, vol. 63 (January 2014), pp.114–124.

[22] Anil K. Gupta, "Innovations for the poor by the poor", *International Journal of Technological Learning, Innovation and Development*, vol. 5, No. 1/2 (2012), pp. 28–39.

A key pillar of its work is to acknowledge and protect the intellectual property rights and contributions of the poor. A number of formal institutions were set up to complement its work, including the Society for Research and Initiatives for Sustainable Technologies and Institutions, a voluntary organization established in 1993, which provides advocacy support as well as financial and technological support to grass-roots innovators. In addition, the Gujarat Grass-roots Innovations Augmentation Network, established in 1997, acts as a type of incubator, linking innovation, investment and enterprise. The Honey Bee Network is an intermediary organization that actively scouts for innovations among local communities, helps to build trust and links grass-roots innovators to more formal institutions.[23] This is particularly important as formal and institutional science can play a role in validating and building on the innovations of people at the grass-roots level.[24]

47. Drawing on the experiences of the Honey Bee Network, the National Innovation Foundation was established in 2000 as an autonomous institute under the Department of Science and Technology to strengthen grass-roots technological innovations and traditional knowledge and to expand the policy and institutional space for grass-roots innovators.[25] The Foundation works to build a register of grass-roots innovations; protect property rights; set up incubators to transform innovations into viable business opportunities; and disseminate innovations on a commercial and non-commercial basis.[26] With the support of the Honey Bee Network, the Foundation has documented more than 225,000 grass-roots innovations from more than 585 districts in India.[27] The Foundation has also filed more than 500 patents in the United States of America and in India on behalf of grass-roots innovators.[28]

48. Fostering grass-roots innovations requires recognizing their value but also addressing the challenges faced by grass-roots innovators. In 2003, the National Innovation Foundation and the Small Industries Development Bank of India established a micro-venture capital fund for grass-roots innovations, which has provided funding to more than 180 grass-roots innovators. The Grass-roots Technological Innovation Acquisition Fund, established in 2011, provides financial incentives for the pooling and diffusion of grass-roots innovations.

4. Technology transfer to support inclusion

49. International technology transfer enables access to existing technologies and takes place through multiple channels, including technology licensing, trade, foreign direct investment and the international movement of experts. Technology transfer requires that recipients, typically firms, are able to identify needs and relevant technologies and to adopt and adapt them to the local context. In least developed countries and other countries with special needs, where the technological capabilities of local firms are limited, international cooperation often plays a major role in supporting not only technologies that serve the needs of disadvantaged communities (such as access to clean and affordable energy by rural communities) but also in

[23] Anil K. Gupta, "Innovations for the poor by the poor".

[24] Anil K. Gupta, "Tapping the entrepreneurial potential of grassroots innovation", *Stanford Social Innovation Review* (summer 2013), pp. 18–20.

[25] www.nif.org.in/aboutnif.

[26] Anil K. Gupta, "Innovations for the poor by the poor".

[27] www.nif.org.in/aboutnif.

[28] Anil K. Gupta, "Innovations for the poor by the poor".

building the technological, market and regulatory elements that enable the diffusion of the inclusive technology.

50. Small-scale hydropower generation solutions are generally implemented in run-of-river schemes or with existing water infrastructure and have the capacity to generate up to 1 MW of electricity. While their capacity to generate electricity is small, they are particularly effective in providing clean energy to rural areas where the population is sparse and electricity demand weak.[29] They require smaller investments and can generate income opportunities in rural areas. Moreover, in contrast to large-scale hydropower installations, they have limited environmental impact. Scaling up access to small-scale hydropower is, therefore, a relevant example of an inclusive technologies and innovation strategy.

51. The Government of Tajikistan, with the support of the United Nations Development Programme (UNDP), has embarked on a comprehensive programme to accelerate the development of small-scale hydropower generation.[30] The programme seeks to remove legal barriers to the broader use of small-scale hydropower, encourage technology transfer related to small-scale hydropower generation, build capacities and develop a market around this technology. The programme links a technology import-based development programme to local actors, including universities, local government institutions and firms.

52. It was carried out in collaboration with, among others, the Ministry of Energy and Water Resources, the Ministry of Economic Development and Trade, the national energy company, municipal authorities, district and regional water management departments, equipment suppliers and construction companies, communities, non-governmental organizations and local training providers.

53. To effectively transfer technologies and support integrated rural development, the programme was designed to build technological capacity and the necessary legal, policy and market elements. The programme has trained local technicians on technical and planning matters and on the operation and maintenance of small-scale hydropower facilities. For instance, technical universities are providing training to 100 students on an annual basis.

54. The Government of Tajikistan has passed laws to support the development of small-scale hydropower. A law on energy efficiency and energy saving, adopted in 2013, established a national renewable energy sources and energy efficiency trust fund. At the policy level, the Ministry of Energy and Industry endorsed three documents providing strategic guidance on the use and scaling up of renewable energy sources and energy efficiency. A national programme for the development of renewable energy sources and the construction of small hydropower plants for the period 2016–2020 was adopted in 2015.

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[29] *The Least Developed Countries Report 2017: Transformational Energy Access* (United Nations publication, Sales No. E.17.II.D.6).

[30] For more information see www.tj.undp.org/content/tajikistan/en/home/operations/projects/environment_and_energy/technology-transfer-and-market-development-for-shp-in-tajikistan.html (accessed 18 May 2018); and Economic Commission for Europe, *Innovation Performance Review of Tajikistan* (United Nations publications, Sales No. E.16.II.E.6).

55. A power purchase agreement for buying electricity from individual power producers was signed by the national energy company, providing a precedent for future individual power producers looking to sell their excess power to the national electricity grid, which should help market development and confidence building.

C. Promoting inclusive growth

56. A third type of approach is inclusive growth approaches that promote inclusive businesses (businesses that include the poor as clients, employees or owners) and industrial inclusion (when micro-, small and medium-sized enterprises can fully participate in economic activities).

1. Promoting inclusive business

57. Inclusive businesses are those whose models include the poor on the demand side as clients and customers and on the supply side as employees, producers and business owners at various points in the value chain.[31] Low-income groups are the largest socioeconomic group but the poorest in resources. Inclusive businesses see opportunities in these markets, for example, with strategies that provide large-scale, low-cost and low-margin products. Inclusive businesses promote inclusion as they expand access to goods, services and income-generating opportunities for low-income groups.

58. The Government of the Philippines is championing the promotion of inclusive business as a strategy to achieve inclusive, innovation-led growth and has introduced a number of initiatives. The first step was the development of an accreditation system for inclusive business models to distinguish them from other types of investment.[32] It also put in place a number of financial incentives and capacity-building programmes to encourage inclusive businesses. For example, the 2017-2019 Investment Priorities Plan provides fiscal incentives for companies with inclusive business models in agribusiness and tourism; the 2017 Sagip Saka Act provides tax incentives to private companies that buy agricultural produce directly from smallholder farmers and fishers; and the "Go local!" initiative supports products produced by the country's small firms through incubation, marketing and branding.[33]

2. Empowering smaller firms to innovate

59. Innovation in the formal economy is inclusive when micro-, small and medium-sized enterprises have the capacities and opportunities to successfully participate in and benefit from innovation. These enterprises often may have more limited awareness of why innovation is important for their business or how to innovate. Smaller firms also have fewer human resources to innovate and financial resources to risk and more limited access to knowledge institutions.

60. Many Asian countries have actively promoted industrial inclusiveness and innovation activities in micro-, small and medium-sized enterprises through policies that seek to address the barriers to innovation. For instance,

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[31] UNDP, *Barriers and Opportunities at the Base of the Pyramid: the Role of the Private Sector in Inclusive Development* (Istanbul, August 2014).

[32] Asian Development Bank, "Accreditation of inclusive business: pioneering IB policy in the Philippines", *Inclusive Business*, 12 February 2016.

[33] UNDP, *New Horizons: How Inclusive Business is Helping Achieve the SDGs in the Philippines* (Manila, 2017).

SPRING Singapore, the enterprise development agency of Singapore, established a comprehensive set of instruments to support innovation activities among local small and medium-sized enterprises. SPRING Singapore provides financing (in the form of innovation vouchers, grants and loans) for these enterprises to innovate. Recognizing that innovation and learning often happen in interaction with other organizations, SPRING Singapore has also promoted collaboration between small and medium-sized enterprises and other small and medium-sized enterprises, industry partners and large organizations.[34]

61. In terms of financing, the Innovation and Capability Vouchers provide small amounts of funding (up to 5,000 Singapore dollars) for small and medium-sized enterprises to procure research and development and other services to improve capacity in innovation, productivity, human resources and financial management. The Capability Development Grant finances up to 70 per cent of a small and medium-sized enterprise's qualifying project in order to enhance the enterprise's capabilities and productivity.

62. In terms of supporting inter-firm collaboration, the Collaborative Industry Projects programme supports collaborations between enterprises and industry partners (for example, trade associations and chambers of commerce) to address common industry-specific business challenges, by financing up to 70 per cent of a small and medium-sized enterprise's qualifying costs for projects in which a consortium of at least three small and medium-sized enterprises participate. Similarly, the Partnerships for Capability Transformation programme supports collaborative projects between large organizations (large firms or government entities) and local small and medium-sized enterprises in certain areas.

3. Enabling the participation of small firms in the digital economy

63. The expansion of information and communications technology (ICT) and its application to the economy, in particular the development of online platforms, is revolutionizing the way in which entrepreneurs and firms conduct business. Small entrepreneurs can now source information and customers online, place orders online, and even sell their products domestically and abroad using online platforms. To do business online, firms must have affordable and reliable access to ICT, be able to rely on a legal environment that recognizes online transactions and have access to an efficient transport network and online payment systems. Additionally, small firms are often confronted with further challenges. Many micro-, small and medium-sized enterprises are not familiar with the technological and marketing skills required to do business online, do not have access to financial resources to move their business online and are not ready to face competition online.

64. In Indonesia, Rumah Kreatif BUMN is an ambitious government programme to build the capabilities of small and medium-sized enterprises to commercialize their goods and services online. The programme is supported by state-owned enterprises that gather, train and support small and medium-sized enterprises. The programme provides enterprises with training, market access and access to financing through three stages: Go Modern (online registration, product standardization and brand management training), Go Digital (training on digital applications, social media and product automation) and Go Online (training on website creation, listing on Blanja.com, and

[34] Jue Wang, "Innovation and government intervention: a comparison of Singapore and Hong Kong", *Research Policy*, vol. 47, No. 2 (March 2018), pp. 399–412.

marketing and inspiration to grow further).[35,36] Blanja.com is a state-owned open marketplace that offers Indonesian firms the opportunity to trade online and has the largest product listing in the country. As of April 2017, more than 482,000 small and medium-sized firms have used Go Modern, 21,577 have used Go Digital and 10,133 have used Go Online.[37]

D. Removing barriers to participation and making technology and innovation activities more inclusive

65. The fourth type of approach refers to strategies targeted at removing the barriers that particular groups, such as women and persons with disabilities, face as producers and consumers of technology and innovation.

1. Supporting girls and women in science, technology, engineering and mathematics careers

66. For technology and innovation to benefit men and women alike, women must be able to participate in, benefit from and decide on technological and innovation activities. The active involvement of women in the design and development of technologies is fundamental if technological innovation is to respond to their needs. For instance, in 2014, a mobile firm released a health application that could monitor a comprehensive set of health metrics – including blood-alcohol content – but which initially failed to track menstruation.[38]

67. Women are not represented equally in scientific, technological and innovation sectors as professionals and decision makers. Gender parity remains elusive among researchers. The gender gap widens with each step up the ladder of the research system. So while women represent 53 per cent of graduates worldwide, only 28 per cent of researchers are female. The gap is not related to a country's level of development. In Asia and the Pacific, the Republic of Korea and Japan have some of the lowest proportions of female researchers, 18 and 15 per cent, respectively,[39] while Malaysia, the Philippines and Thailand have all achieved gender parity. The gender gaps are sector specific; for example men are underrepresented in health while women are strongly underrepresented in engineering and in ICT. Talent shortages in certain job families, notably those requiring digital skills, are a strong incentive for the private and public sectors to support increasing participation of women in scientific and technological careers.

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[35] Wirawan Agahari, "Digital Economy and Inclusive Development: Insights from Indonesia", PowerPoint presentation, 11 and 12 April 2018. Available at https://diodeweb.files.wordpress.com/2018/04/diode18n.an-agahari-digital-economy-and-inclusive-development-in-indonesia.pptx.

[36] Jakarta Globe, "TelkomGroup Encourages Go Global Through E-Commerce Training and Online Marketing at Blanja.com", 22 September 2017. See http://jakartaglobe.id/advertorial/telkomgroup-encourages-go-global-e-commerce-training-online-marketing-blanja-com/.

[37] Rumah Kreative Kreatif BUMN, Lokasi RKB. Available at http://rkb.id/lokasi#page-4 (accessed 7 May 2018).

[38] World Economic Forum, "The tech industry needs more women. Here's how to make it happen", 9 November 2017.

[39] United Nations Educational, Scientific and Cultural Organization (UNESCO), *UNESCO Science Report: Towards 2030 – Executive Summary* (Paris, 2015).

68. The impact of frontier technologies on women is likely to be different than it is on men. Artificial intelligence algorithms are reproducing, even exacerbating gender and racial bias in various ways: gender bias in the data sets used to train artificial intelligence systems are being reproduced and systems providing personalized information (for example, social online platforms) are feeding information that reinforces user biases.[40] In terms of employment, women will likely benefit less from new job opportunities in frontier technologies given gender differences in fields of study.[41] Women are already a minority in jobs and in decision-making positions in science and technology-related occupations. For instance, in the software and information technology services industry, women represent only 27 per cent of employees and 19 per cent of leadership hires.[42]

69. Closing the gender gap in scientific and technological careers involves building balanced educational foundations, fixing the leaking pipeline in scientific research careers and rebalancing gender asymmetries in engineering and information technology industries.

70. The Government of Malaysia has a long history of supporting a gender balance in science and technology education and has introduced policies promoting greater workforce diversity. As a result, the overall number of women researchers is close to parity, although in the private sector only 30 per cent of researchers employed in 2013 were women.[43]

71. In order to become a developed country by 2020, the Government of Malaysia, in 2010, set a national goal of producing 1.3 million specialists in scientific and technological fields by the year 2020. Promoting women's interest in science, technology, engineering and mathematics studies is one vehicle to achieve that goal.

72. Participation of girls in scientific and technological studies has improved gradually over four decades due not to a specific strategy but to the inclusion of gender considerations in key national policies in the areas of education, economy, and science and technology.[44]

73. Since the 1970s, the Government of Malaysia has adopted a 60:40 enrolment policy to ensure that 60 per cent of the students, both in secondary and higher education, are enrolled in science. Under this policy, students that score an A or B in science and mathematics at the lower secondary assessment are automatically placed in the scientific stream at the upper secondary level. This policy has facilitated the selection of students that have the necessary aptitude and has contributed the most to increasing the participation of girls in science and technology education.

74. The objective of this policy has proved difficult to achieve. The Malaysia Education Blueprint 2013–2025 seeks to encourage further interest

[40] Kristian Hammond, "5 unexpected sources of bias in artificial intelligence", 11 December 2016; European Political Strategy Centre, European Commission, "The age of artificial intelligence: towards a European strategy for human-centric machines", EPSC Strategic Notes, No. 29 (2018); and World Economic Forum, "AI has a gender problem. Here's what to do about it", 16 April 2018.

[41] OECD, *The Pursuit of Gender Equality: An Uphill Battle* (Paris, 2017).

[42] World Economic Forum, *The Global Gender Gap Report 2017* (Geneva, 2017).

[43] UNESCO, *UNESCO Science Report*.

[44] This section draws largely on UNESCO, "Sharing Malaysian experience in participation of girls in STEM education", In-Progress Reflection, No. 3 (Paris, 2016).

in science and technology by promoting teaching and learning approaches that stimulate higher-order and design thinking skills; awareness within the school community; and the use of ICT in teaching and learning. The second and third implementation phases have specific objectives on reducing gender gaps in students' achievements, which for Malaysia means focusing on boys who leave school early or have low results, as girls consistently outperform boys at every level of education.

75. Science and technology professional bodies, such as the Academy of Sciences Malaysia or the Malaysian Institute of Chemistry, are also encouraging science and technology education for all. Awareness has been raised in government ministries and private sector organizations on the different and unique capabilities that women bring to the workplace. A biennial Women in Science, Technology and Innovation Forum has been institutionalized in collaboration with UNESCO.

76. Gender inclusiveness is also considered in the selection of pedagogies and the design of scientific curricula. Most female role models in science and technology in Malaysia took science or technology courses or chose their careers based on their interest in exploring and doing experiments. Pedagogies supporting these approaches are now encouraged. Specific rules were made regarding the gender of members of the panels of experts invited to develop various curricula, in addition to other gender components of curricula development (for instance, ensuring that illustrations in text books are gender responsive).

77. The Government has aimed to increase the number of women participating in the labour force and, more recently, the quality of their participation by promoting women in decision-making positions.[45]

2. Promoting assistive technologies for persons with disabilities

78. Persons with disabilities are often at a disadvantage when trying to use ICT. Access to assistive devices and related support services is a precondition for persons with disabilities to optimize their level of independence in daily life and to live in dignity.

79. The Incheon Strategy to "Make the Right Real" for Persons with Disabilities in Asia and the Pacific guides the third Asian and Pacific Decade of Persons with Disabilities, 2013–2022. The Strategy set 10 priority goals, including enhancing access to the physical environment, public transportation, knowledge, information and communication (Goal 3), and its specific targets include enhancing the accessibility and usability of information and communications services (target 3.C) and halving the proportion of persons with disabilities who need but do not have appropriate assistive devices or products (target 3.D).

80. A 2018 report assessing the progress of the Incheon Strategy indicates that, of the 14 Governments that provided information, more than one third of persons with disabilities, approximately 7.5 million people, had no access to the required assistive devices.[46]

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[45] Malaysia, Economic Planning Unit, Prime Minister's Department, *Tenth Malaysia Plan 2011–2015* (Putrajaya, 2010).

[46] Economic and Social Commission for Asia and the Pacific (ESCAP), "Inequality of opportunity in Asia and the Pacific: education", Social Development Division Working Paper Series (ST/ESCAP/2817).

81. Several elements are required for persons with disabilities to benefit from assistive technologies. These elements include awareness; advice and assessment of needs to identify personal technology; provision of assistive technology with a clear system of funding; training in the use of assistive technology for professionals and for persons with disabilities; technical support to implement customized and personalized assistive technologies; availability of accessible digital content; research and development; and the implementation of relevant policies (such as the right to accommodation, anticipation and redress).

82. Governments can actively encourage the availability, through regulation and soft measures, of these elements in a coordinated and coherent manner.

83. Recent research conducted in five developing countries, including Malaysia and Pakistan, suggests that there is a gap between the policies in place and the experience of access to assistive technologies.[47]

84. This research found weaknesses in all five countries and found that most countries had inadequate systems for providing and supporting assistive technologies. Common weaknesses were related to awareness, advice, provision, training, support, and availability of accessible digital content, while the areas of greater strength were policy and research and development. The research also indicates clearly that the provisions made for different forms of disability vary considerably.

85. Persons with disabilities have sought to address weaknesses in the ecosystem through their own networks and activities, and the use of social media and messaging is providing the basis for increased awareness and decision-making. Research indicates that there is an underlying trend of users self-determining solutions. This user-led model reduces the cost of provision significantly and offers opportunities for governments to invest in sustaining and strengthening emerging networks with information and resources.

86. Technologies implemented on mobile and portable devices dominated provision. This suggests that additional innovative methods of service delivery could expand and enhance the ease of access to technology for persons with disabilities. The use of open licence solutions has supported the localization of assistive technologies and helped to address language and cultural differences.

VI. The Commission's work on inclusive technology and innovation policies

87. The secretariat conducts research and analysis, promotes intergovernmental dialogues, and builds capacities in the areas of science, technology and innovation policies.

88. In order to support member States' pledge to leave no one behind and the commitments contained in Commission resolution 74/11 to maximize the positives of science, technology and innovation and to minimize the possible negatives, the secretariat is establishing a new programme on inclusive technology and innovation policies.

[47] Based on a preliminary assessment of research findings, as shared by Mr. Akber Gardezi, Inter Islamic Network on Information Technology, based at COMSATS University, Islamabad (11 May 2018). The research was conducted in Jordan, Malaysia, Pakistan, Qatar and Tunisia.

89. The programme will bring additional strategic expertise to member States and enhance the Commission's work on science, technology and innovation policies by filtering through an inclusive lens its existing work on research, capacity-building and dialogue on science, technology and innovation policies (for example, by examining the implications of frontier technologies for low-income and other marginalized groups). It will also build upon and contribute to the secretariat's work on social development, such as poverty and inequality, women's empowerment and gender equality, and inequality or disability-inclusive development.

90. The programme will support Governments across the region in their efforts to design and implement inclusive technology and innovation policies by offering advisory services to those wishing to promote more inclusive innovation, conducting research and providing a platform for expert and policy discussions.

VII. Conclusion

91. It is possible to formulate technology and innovation policies that support more inclusive development. Supporting inclusive technology and innovation poses a number of questions that require further exploration, analysis and deliberation by policymakers and stakeholders.

92. The first issue is how to put inclusiveness high on the political agenda so that the needs of disadvantaged communities are given due consideration in science, technology and innovation policies and, subsequently, how to reconcile economic growth objectives with inclusion objectives.

93. Inclusion outcomes are often loosely defined in national science, technology and innovation policies. How can vague inclusion outcomes be translated into specific inclusion objectives in technology and innovation strategies and plans?

94. A third technology and innovation policy issue is prioritizing among multiple inclusion needs. Given that resources are limited, on which vulnerable groups should science, technology and innovation policies focus? How should priorities be decided? In which areas (for example, women in scientific and technological careers, frontier technologies, inclusive growth, grass-roots-based development) can technology and innovation policies have a greater impact in promoting inclusion?

95. Different perspectives (inclusive economic growth versus social justice) and diverse, even contradictory, options (from bottom-up to top-down approaches) can support inclusive innovation. How much attention and resources should be dedicated to the different approaches?

96. A variety of policy instruments encourage inclusive technologies and innovations, including enabling regulatory environments, supportive public procurement policies, focused research programmes, financial support and incentives, and establishing supportive institutions and programmes. Which is the right policy mix in each context?

97. Finally, traditional technology and innovation indicators are not adequate for recognizing the value and shortcomings of inclusive innovation and technology initiatives. How can policymakers and other stakeholders monitor and evaluate inclusive innovation and technology policies when traditional indicators (for example, expenditure in research and development, productivity growth) are not relevant?

VIII. Issues for consideration by the Committee

98. The Committee may wish to discuss the issues raised in the present document and share experiences and lessons learned with regard to inclusive technology and innovation policy.

99. Given the large number of avenues to support inclusive innovations and of policy issues requiring further exploration, member States are invited:

(a) To identify priority inclusive technology and innovation policy issues that ESCAP should explore in more detail;

(b) To indicate areas of inclusive technology and innovation policies that are being considered and may require support from the secretariat in the form of training, research or advisory services to guide the development of inclusive technology and innovation policies;

(c) To suggest areas for cooperation on inclusive technology and innovation policies to support shared prosperity.